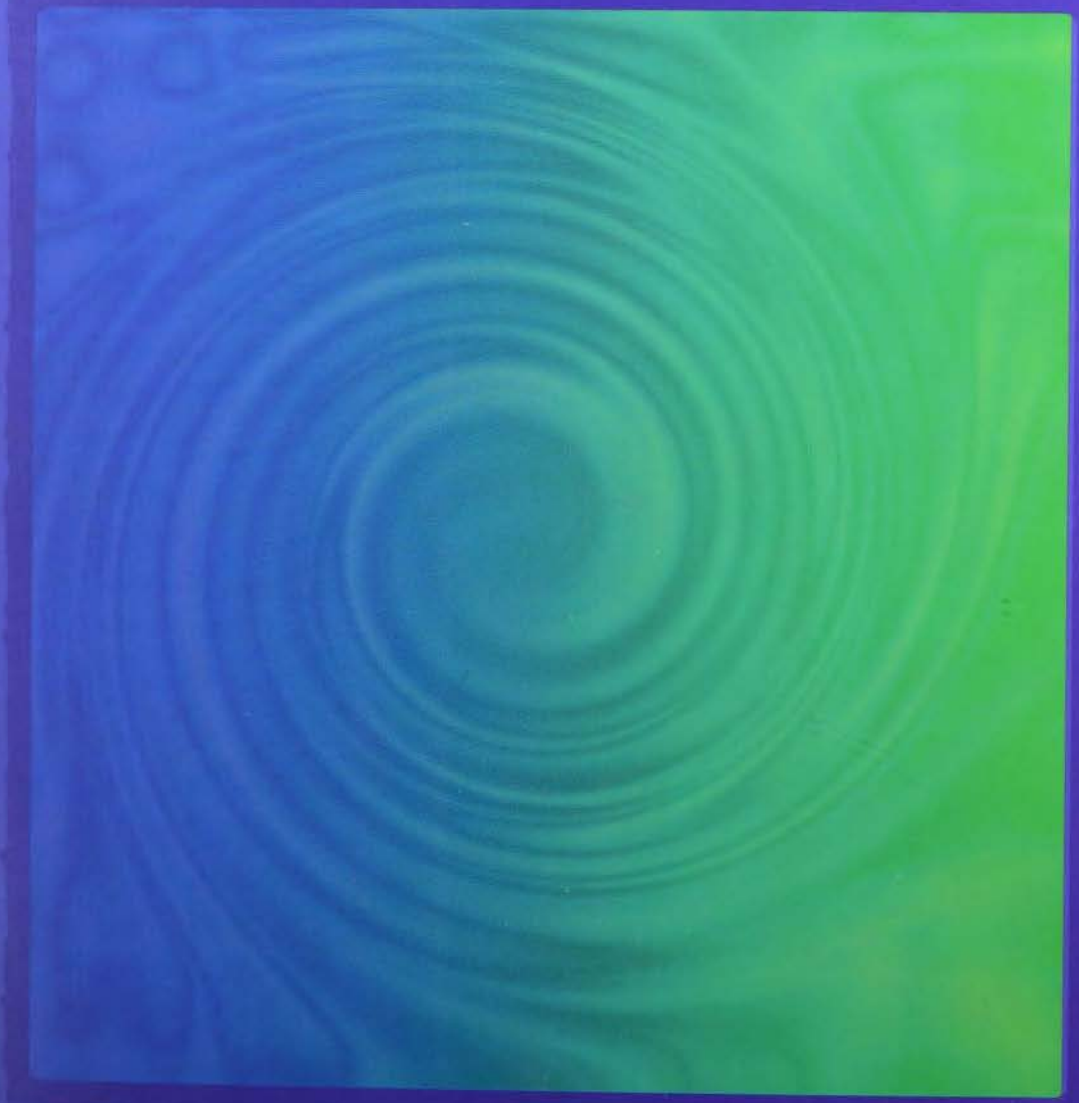
Scientific Theology



Paul A. L. Giem

Scientific Theology

For many in the modern world there is a belief of a great gulf fixed between science and religion. Dr. Giem sets about showing how that belief is not necessarily true. In order to bridge the gulf, one must examine both science and religion to show how both of them may have been misinterpreted. This is a large task, but Dr. Giem pulls it off remarkably well. He sets forth a clear understanding of biblical truth, especially in those areas that touch human nature and the human pursuit of science. Inevitably one must confront those areas in science where others have seen a tension between it and the Bible. This task is focused in the areas of dating methodology. This subject involves both radiometric dating and radiocarbon dating. In his sections dedicated to these subjects, he shows these methods may not have been handled as well as previously thought, and it may be necessary to revise the chronologies that these methods have provided us to a considerable extent. In both of these major areas of study here, Dr. Giem has provided us with a careful and thoughtful presentation. This work is strongly recommended to interested readers, especially those who would like to see a reconciliation between science and religion. — ***Wiliam H. Shea, Ph.D., Biblical Research Institute, Washington, D.C.***

Paul Giem's *Scientific Theology* is a remarkably fresh academic foray into the hoary tradition of uniting science and religion. Giem avoids overstating his arguments, and also identifies alternative positions and their rationales. His technical evaluation of the various radiometric dating methods is a virtual *tour de force* in suggesting that without altering the radioactive time constants the results seems to be more compatible with a short chronology of life on earth than with a long chronology. This book is important and one worth reading. — ***John T. Baldwin, Ph.D., Professor of Theology, Andrews University Theological Seminary. Author of "God and the World: Wiliam Paley's Argument from Perfection Tradition — A Continuing Influence,"*** **Harvard Theological Review.**

Dr. Paul A. Giem received his bachelor's degree in chemistry from Union College, Lindoln, Nebraska (1973), his MA in Religion (Biblical Studies) from Loma Linda University (1977), and his MD degree from the School of Medicine at Loma Linda University (1980). He currently practices emergency medicine in Loma Linda and Los Angeles and teaches medicine and religion at Loma Linda University where he is a clinical instructor in medicine. He is married to Marla Giem, MD. They have five children.

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Dedication

To my father, Dr. Ross Giem

Preface

The purpose of this book is to propose the use in theology of a method that has been developed primarily in the field of science. The method itself is described in chapter 1. It is applied to the general subject of inspiration and revelation in chapter 3. Several other applications are discussed in chapters 6, 7, 8-9, and 10, to give the reader some concrete examples of how I believe the method should be used.

However, one does not work on theology in a vacuum. Our age is one in which the possibility of the supernatural is often denied, especially by scientists and intellectuals. Therefore I have felt the need to deal with the question of the supernatural in general (chapter 2), and with the question of the validity of the Bible in particular (chapters 4 and 5), in as fair a way as possible.

Part of what I see as the scientific method is stating the evidence and the inferences one draws from that evidence as clearly as possible, and avoiding trying to settle disputes by appealing to authority, except as that authority can be accepted by both sides of a given issue as based on evidence and inferences therefrom,

and thus scientific itself. The scientific method has no use for authority *per se*. It is to be hoped that responses will be in kind.

I come from a religious background that values the study of nature because it is "God's second book", for which I am thankful. I have been interested in the relationship between science and theology at least since I started college with a double major in theology and chemistry. My interest continued to grow as I took courses for a M.A. in religion while getting my M.D. at Loma Linda University. While studying theology, I became convinced that science had something to offer to theology. The most obvious case was that of revelation, where a fundamentalist approach often required denying the existence of apparently minor errors which seemed inconsequential but which also seemed to clearly be errors. On the other hand, a liberal approach seemed to degenerate into "I like it", with no authority to determine a course of action. The model of a scientific text seemed to avoid the problems with both approaches; the authority of a scientific text is not invalidated with the first error discovered. Thus chapter 3 was born. This required justification of the methodology, and chapter 1 was born. The book just kept growing from there. In fact, if I had not deliberately stopped, it would still be growing.

I am deeply indebted to many people for the ideas in this book. Some of them I have never met, such as C. S. Lewis and Nancey Murphy. Others have stimulated my thinking in discussions, such as James Melancon, Erwin Gane, Jack Provonsha, Dalton Baldwin, Franklin Dailey, and Ed Zinke. Some have also read the manuscript or parts of it and provided helpful suggestions, such as Robert Melashenko, A. Graham Maxwell, David Larson, Robert H. Brown, Ben Clausen, Elaine Kennedy, R. Ervin Taylor, Ruth Edwards, William H. Shea, Glenn Rouse, David Hessinger, Patti Rippon, and Arlene Klooster. I am sure that this list is incomplete and I apologise to those whom I inadvertently omitted. The people on this list are, of course, not responsible for any errors I have made (some of them disagree with major portions of the book). However, I deeply appreciate the contributions they have made. Thanks are due to Farzaneh Alemozaffar for her help in obtaining reference materials, which were sometimes rare and difficult to locate. Thanks are also due to Christina Heinkel, Volker Stieber, and Hanni Bennett for help in translating German. I also wish to express my appreciation to my wife Marla, not only for helpful comments but for going out of her way to give me time

to study and write, without which this book would never have been completed.

Finally, I wish to thank my father, Dr. Ross Giem, to whom this book is dedicated, for his instilling in me at an early age, by both precept and example, the twin ideals of a passion to find truth and a concern for fairness, without which that passion so easily short-circuits. I will be forever grateful to him for this.

Introduction

You may be among those who have religious beliefs which you value dearly, and have been trained in the method of science and scientific knowledge for which you have great respect. These two systems of thought often seem not just non-supportive of each other but actually contradictory. It is for you especially that this book is written. I believe that the attempt to integrate these two systems should be made, and I believe that I have been at least partly successful in this attempt. If so, the concepts here outlined and the evidence behind them should come as a relief to you.

You may have come from a background where science was valued and religion, or at least theology, much less so. If so, you may be surprised to learn that theology has something worthwhile to say to science, and that it can make testable predictions (some of which actually have the weight of evidence supporting them, and which would not have been made from a point of view which only values the current "orthodox" view of science). I believe that the book makes a reasonable case for this statement.

You may have been taught that science could not usefully supplement the truths of revelation, or perhaps the subject was not even addressed and it was simply assumed that theology had no real need for science. I intend to reasonably demonstrate that science, and in particular scientific methodology, can make a real contribution to theology. But first I should point out that such a contribution needs to be made.

It is tempting to say that all we must do is to believe. The question then comes, believe what? We can believe what our particular denomination says. But how do we know that our denomination has the truth, rather than some other? And what do we do if our denomination splits into two or more parts? Does the majority vote win? Do we go with the one which our particular congregation chose? Most of us would not be satisfied with these kinds of answers. There must be some more objective way of deciding the question.

Perhaps we should follow the Bible, and go with the denomination that most closely follows its teachings. But then how do we interpret the Bible? That question is one of the major driving forces behind the splintering of Christiantiy into denominations. And why pick the Bible at all? Why not use the Vedas, or the Qur'an (or Koran), or some other holy book? Or why not, as secular humanism has done, dispense with holy books altogether?

In asking the questions, I am not saying that there are no answers, or even that we cannot find them. But I am pointing out that they need to be addressed, and that we cannot simply assume the validity of the Bible without further discussion as to why and in what way it is valid.

There is another way of dealing with the problem of what one should believe, especially tempting to those who are sick of all the fighting, bigotry, greed, duplicity, and assorted evils that often attend religious controversies. It is to say that what counts is to be decent people, and that church doctrines really don't matter and fighting over them is a sin. I'll believe what I want to believe, you believe what you want to believe, and if we just treat each other like Christians, we'll all be just fine.

There is a lot of truth in this. I believe that if we spent as much time watching the tone in our voices when we discussed doctrines or church politics as we do defending the positions we took, we would be far ahead of where we are now. Many debates would change into constructive sessions, and we could find solutions for most of the problems that divide us.

But there are some serious flaws in this position. First, and easiest to remedy, is the fact that the idea that we should treat each other like Christians is nothing more or less than a doctrine. Most Christian churches profess this doctrine. At least one doctrine must be allowed. In order to avoid this criticism, the position must be modified, somewhat like this: The only really important doctrine is that we should treat each other like Christians. Any other doctrine is not worth worrying about. You can believe whatever else you like as long as you treat your fellow humans decently.

But now a second flaw must be considered. What does it mean to treat each other like Christians? We will get different answers from different Christians. For example, some fundamentalists will say that we should not engage in premarital sex, but it is all right to pass laws demanding the death penalty for certain crimes, whereas many more liberal Christians would say that premarital sex can be a very positive experience, and the death penalty is as unchristian as you can get. Clearly, they both can't be right. If one is to mean anything by the call to act like a Christian, one must specify what Christian actions are. We cannot treat each other like Christians without a system of ethics.

Nor will a common perversion of the Golden Rule—"Do unto others as they wish to have it done unto them"—suffice for the foundation of ethics. First, it is not Christian. Jesus Himself said some things to the Pharisees and lawyers in Luke 11 that I am sure most of them did not want to hear. Second, it is not practical. There are many times when people have conflicting wishes, and this ethic gives us no guidance in choosing the proper course of action in these instances. Third, it is not humane. There are times when, for example, an alcoholic should not be given what he obviously desires at that moment, because his desires are not in line with his own future happiness, let alone anyone else's. We have to do unto others, not as they wish, but as we would (or more properly, should) wish to have it done to us if we were in their place. That is, we should work for their best good. But this concept requires us to have some idea of what is good for people. We have discovered that philosophy enters the picture.

This brings us to the final flaw in the position we have been examining. It assumes that other doctrines have nothing to do with whether we behave like Christians. I think this assumption is highly improbable. How do you, for example, urge good Jews

and good Moslems in the Middle East to "act like Christians" without changing their theology? The concept of holy war is a part of both systems.[1] As William Hordern put it so succinctly, "Christian theology is nothing more or less than the attempt to change the thinking of men so that they will act as Christians."[2] We do not have the choice between theology and no theology. If we wish to have any kind of morality, we only have the choice between muddled theology and theology that is more clearly thought out.

So we really cannot avoid tackling some controversial theological questions. Does God ever intervene in history? How dependable is inspiration? Is Evolution compatible with the Bible? If so, how? If not, which is right? What is the relationship between divine foreknowledge and human freedom? What must I do to be saved (or can I be saved)? Does God torture people in Hell forever? If so, how can this be justified? If not, what does God do?

It may not be possible to settle all of these questions to the satisfaction of everyone. I am certain that it cannot be done in the space that follows. What I will do is to introduce you to a method of solving such questions that can provide a basis for action, while still allowing for the possibility of future correction. It can also allow one to see marked similarities in apparently contradictory theological positions, while highlighting differences which at first seem minor. The rest of this book will describe what I choose to call scientific theology and to explore some applications. Then you, the reader, may judge whether this method is worthy of your trust.

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[1]The current peace process demonstrates, if anything, the decline of the power of both fundamentalist Moslem and Jewish convictions, and at least in part demonstrates the rising power of a secular humanism somewhat influenced by a Christian understanding of love to one's neighbor.

[2]*A Layman's Guide to Protestant Theology.* Revised edition. London, The Macmillan Company, 1968, p. xv.

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Scientific Theology

Many think the term scientific theology is an oxymoron. Theology, they say, has to do with God and the supernatural, and science is the study of nature. The two have nothing to do with each other.

The thesis of this book is that science and theology have profound interactions with each other. I have chosen to use the term scientific theology for the synthesis I will describe. Scientific theology gets its name from two important properties. It attempts to fully integrate science into theology, and it views theological theories as analogous to scientific theories.

Integrating Science

Part of what I mean by scientific theology is a theology that interacts with science. It takes the findings of science into account, and it has something to say to science. Science and theology both approximate truth, and therefore must fit together harmoniously where they overlap. We do not have one truth for science and another for theology. The central tenet of our Judeo-

Christian heritage is stated in Deuteronomy 2:4. "Hear, O Israel: The LORD our God is one LORD."[1] We should not have one god for sociology and another for chemistry and another for history and another for religion, any more than our spiritual forefathers should have had a god for the sky and another for the river and another for the earth. Polytheism is as unsatisfactory now as it was then.

There is a very practical reason why this is so. Suppose that a scientific theory states that it is impossible to resuscitate anyone who has been dead over 1 hour, and that a theological doctrine states not only that one man rose from the dead after being dead over 24 hours, but that all the dead will rise someday. We cannot base our actions on both statements. If a logical conclusion of the scientific theory is "when asked, tell people that this life is all they have, so get the most pleasure out of it", and a logical conclusion of the theological doctrine is "tell others that there is another life and they should prepare for it", then we cannot do both at the same time. We must choose one of the two actions (or a third action) and thus implicitly support one theory or doctrine as being superior to another.

Scientific theology thus parts company with two popular ways of resolving the tension between science and religion, fundamentalist obscurantism and liberal dichotomism.[2] Fundamentalist obscurantism says that we need not pay attention to science; just believe the Bible. This is an easy way of solving the problem, but it starts to break down when it is exposed to modern life. For the same people who say they ignore scientific findings broadcast programs (using the results of physical science) and drive cars (using the results of thermodynamic theory) using gasoline (obtained by applying the results of geological science and chemical science). When they become ill, they visit physicians for the application of medical science. Somewhere they have to draw the line between acceptable and unacceptable science; otherwise they would be accepting what they condemn. Fundamentalist obscurantism is not really a live option.

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[1]RSV. All biblical quotes are from the RSV unless otherwise specified.

[2]That is not to say that all fundamentalists are obscurantists or that all liberals are dichotomists, but that a common way for liberals to approach the problem of the interaction of science and theology is to create a dichotomy, and that a common way for fundamentalists to approach the problem is to attempt to ignore it.

This is not to say that all the conclusions of science should be taken at face value. The majority of scientists have been mistaken in the past, and there is no guarantee that the conclusions of today are free from error; good scientists will say as much. A theological conservative who attempts to find places where scientific conclusions need to be modified is not necessarily out of line. But one should not ignore the conflicts between current scientific thought and one's religion and hope they will go away. They will not unless someone works on the problem.

Liberal dichotomism, on the other hand, attempts to make an absolute distinction between science and theology. Science is alleged to deal with questions of fact; theology to deal with questions of meaning and value. The two have no relationship to one another.

Again, this position is not entirely irrational. One cannot get from the physical facts of our universe to a moral duty without adding something else. As it has sometimes been put, you cannot get an "ought" from an "is". Science cannot deal directly with ethics unless some basic principles are added.

But there are problems with this position. First, science does not deal with questions of fact, but only with reproducible events and theories built around them.[3] There remains the possibility that some events are not reproducible without taking factors other than physical ones into account. Science is not incompatible with such events; it merely cannot predict or explain them. A theology

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[3]This is a common definition of the realm of science, and probably the best one. It differentiates science from history, art, and philosophy. It would count physics, chemistry, most of biology, and parts of geology and medicine as sciences, as well as some sociology. The only other common definition of science, that which can be described by mathematics, arrives at a somewhat similar list, although it would include music and mathematics as science and exclude some descriptive parts of biology which are reproducible but not yet mathematically formalized.

Some would say that this definition of science can account for the entire universe (they therefore try to define science as both the study of the reproducible and as the study of everything in the universe). But this concept is not logically necessary. It belongs to the presuppositions of scientism, the belief that all events are reproducible and independent of direct effects of the thoughts of intelligent entities. And it still ignores the problem of history, and that of initial conditions. We will consider scientism in the next chapter. For now I would prefer not to beg the question by including the concept of comprehensiveness in the definition of science.

that incorporates both science and history may do a much better job of explaining and even predicting such events. Thus theology may deal with facts, and may even do it better than science.

Second, the inference of meaning or value is often dependent on fact. One can hardly speak of the meaning of the Exodus, or the crucifixion or resurrection of Jesus, or Mohammed's visions, or Joseph Smith's translating the golden plates, if these events did not in fact happen (one may perhaps speak of the meaning of the story, but not of the event itself). Even in the field of ethics, the factual question of whether brain function can be restored, and how much, may determine the value of treating someone who is critically ill. Facts, and even science, can intrude into questions of value.

So the liberal dichotomist distinction will not do. Science may be morally neutral, but good theology must incorporate science, and other systems of fact such as history, into its structure.

Using the Scientific Method

But I mean more by scientific theology than merely a theology that takes science into account. I also mean a theology that uses the method of science. That is, one makes observations, tries to organize them into coherent theories, or doctrines, and then tests those theories against further observations. When doing this, one always recognizes that the observations, when well-established, are of primary importance: If a theory comes in conflict with an established fact, it is the theory that must be modified or rejected.

This is a brief and therefore somewhat simplified description of the scientific method. It may come as a surprise to some that there is not complete agreement in the scientific community as to what constitutes the scientific method. Most scientists actually do not have a well-articulated philosophy of science. They tend to evaluate scientific theories by partly instinctive criteria.

On the other hand, philosophers often do not have the scientific background to develop these instincts. They also have the problem of demarcation. Where is the scientific method best demonstrated? Most people would agree that physics and chemistry are science, as well as large portions of biology and medicine. Many people would add geology. There is more doubt about psychology, economics, and sociology. Few people consider art, his-

tory, and religion scientific. And Marxist theory has, I think, had the last shreds of its scientific facade torn from it in the last few years. Where does one draw the line? And when does a discipline become scientific? In addition, is the scientific method anything scientists do, or are there normative principles that scientists should follow, and that will impede progress if not followed? These questions do not have universally obvious answers. To get a better articulated description of the scientific method, perhaps we should review a thumbnail sketch of the history of the philosophy of science.

Science started in an atmosphere where the only knowledge that counted was that which was absolutely certain. Then came the age of enlightenment, which was heavily influenced by two sets of events. First there was the Protestant Reformation, the uncertainties it engendered in religion, and the horrible persecutions and wars that followed.[4] The conclusions that were often drawn were that religious knowledge was not certain, that using force to coerce religious belief was futile, and that coercing religious practice was wrong. The conclusion was even commonly drawn that religious knowledge was worthless. At the same time Newton produced a theory which stunned the world with its simplicity, scope, and accuracy. These same people believed that scientific knowledge was certain, and attempted to account for its certainty. But no matter how hard they tried, they were not able to reduce science to absolutely certain principles. Newton himself was unable to explain the nature of his mysterious gravitational attraction from first principles ("*Hypotheses non fingo*"). Thus one could not deduce science. But that left trying to induce science from observations. Thus was born inductivism.

Inductivists believed that no theory should be accepted until it is proved by observations, and that once it is proved it will never have to be discarded. Inductivism initially was optimistic about the ability to produce an absolutely true science from observation. But then Newton's theory turned out to be wrong, or

[4]This is not to say that the Reformation caused the uncertainties or the persecutions. It merely underlined the uncertainties and demonstrated that apparently sincere Christians could kill apparently sincere Christians for their beliefs (previously most well-known persecutions by Christians had been of pagans or members of other religions like Islam or Judaism)

at least not absolute truth. Inductivism had failed in practice. And it was noticed that nothing can be absolutely proved by induction alone.

So inductivism degenerated into logical positivism, which took the tack that only sense data, and statements that could be reduced to sense data, were reliable. All other statements were "meaningless". But then it was noticed that scientific hypotheses could not be completely reduced to sense data. This would mean that science was meaningless, which seemed (and seems) absurd. Hypotheses in science generally are attempts to extrapolate from sense experiences to some kind of order behind them. Scientists believe in the sun as a real object behind the light streaming toward us. It seems pointless to deny the reality of such constructs. And it must even be granted that sense experience is not the ultimate arbiter of reality. Witness our reliance on thermometers for temperature evaluations instead of our sense of heat or cold, and our rejection of a blind person's denial of the existence of a rainbow.

Karl Popper advanced beyond the logical positivists when he pointed out that the distinguishing feature of a scientific theory was not the ability to prove it, but the ability to falsify it. This meant for the early Popper that although we could not know truth for certain, we could at least know error.

However, scientists do not spend their time trying to make hypotheses so that they can falsify them; rather they try to find hypotheses that can be falsified but have not been. They then try to predict new events using their hypotheses. The hypothesis that can predict the most events accurately is the preferred one. What actually happens is that a good scientific theory says, "If A or B (or C, etc.) could happen, given these circumstances A will actually happen." The more events ruled out by the theory, the more useful the theory. By the same token, the more events ruled out by the theory, the more falsifiable the theory. So falsifiability and predictive power are two sides of the same coin. But scientists actually want the predictive power side.

Furthermore, certain basic hypotheses, which we might call central theories (a theory is simply a hypothesis that has a certain amount of corroborating data behind it), are exceedingly difficult to falsify. They often make no direct contact with experimental data, and one can always say that the anomaly will be resolved with further data and/or theory. In fact, even the data

are not logically certain. As Popper noted,[5] they are accepted on the basis of a decision, very much like a jury decision and subject to the same biases. "The empirical basis of objective science has thus nothing 'absolute' about it."[6]

Imre Lakatos extends this idea to mathematics, with striking results.[7] Thus even in mathematics, which we have always thought of as absolute, our knowledge is not absolute and incapable of falsehood.[8] *Thus there is no absolute certainty of any kind in science.* But science still is impressive as a working system.

Lakatos set out to explain this. He postulated scientific research programs (or SRP's), which consist of a "hard core" of unmodifiable theories, and a "protective belt" of modifiable theories surrounding the hard core, which was added to guided by a positive heuristic, or coherent plan for solving problems. He valued SRP's for their ability to predict novel facts. An SRP which was continually producing novel facts was progressive, and one which was not was degenerating.

He defined a novel fact as a fact which was not known at the time the theory was proposed. Nancey Murphy[9] offers this redefinition: "A fact is a novel fact if it is one not used in the construction of the theory T that it is taken to confirm. A fact not used in the construction of the theory is one whose existence, relevance to T, or interpretability in the light of T is first documented after T is proposed." I would only add, with Elie Zahar,[10]

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[5]*The Logic of Scientific Discovery*. New York: Harper and Row, Publishers, 1968, pp 108-111.

[6]Note 5, p. 111.

[7]*Proofs and Refutations: The Logic of Mathematical Discovery*. Cambridge: Cambridge University Press, 1976.

[8]For those who have difficulty believing this , I suggest they read the book. Not counting the appendices, it is short (125 pages) and can be understood by someone with high school geometry and algebra, except for one short section on vector algebra which one does not need to understand to follow the argument.

[9]*Theology in the age of scientific reasoning*. Ithaca, NY: Cornell University Press, 1990, p. 68. Her definition was actually made after Zahar's (see note 10). The reasons for her definition are given in her book.

[10]See "Why did Einstein's Research Programme Supersede Lorentz's?" *The British Journal for the Philosophy of Science* 24:95-123 and 223-62, 1973. Reprinted in Howson C (ed.), *Method and Appraisal in the Physical Sciences*. Cambridge: Cambridge University Press, 1976. Also see Lakatos I: *The Methodology of Scientific Research Projects*. Cambridge: Cambridge University Press, 1978, pp. 184-189.

that even a fact whose existence, relevance, and interpretability in the light of T are documented when T is proposed is of significant positive value if T does not require modification to account for that fact. Thus the explanation of Copernicus for Mercury and Venus never being seen opposite the sun and the retrograde motions of the outer planets always being opposite the sun flows naturally from his theory, whereas the Ptolmaic system (or systems) had to tack that condition onto their theory. This may be taken as one aspect of the simplicity of a theory (one may argue that semantically it is not a "novel fact" but it is certainly significant)

His system should also be modified in the directions suggested by Alan Musgrave.[11] First, "hard cores" develop naturally, and do not need any dogmatic protection. Central theories survive primarily because they are good. Second, heuristics are not all-powerful. They need facts to determine their precise implementation, and they can still get stuck on stubborn facts (or more precisely, stubborn combinations of facts). This can appropriately cause what Thomas Kuhn would call a crisis. And some facts are more stubborn than others. If stubborn enough, they may even be closer to "falsifiers" than anomalies. Finally, although the later Lakatos backed away from saying so, scientists in general should support what they perceive as progressive research programs more than degenerating ones. This does not mean that a scientific community should coerce someone who does not agree with them about the relative merits of the programs under consideration. After all, he may have more insight than they. But it does mean that they are not obligated to finance him.

I might add that no theory needs to be (or should be) thrown away completely as long as it can serve as an approximation in some area. Since none of our theories are expected to be totally perfect, having a theory with known limitations can be very useful for guiding actions within its domain of relative accuracy. This means that Newton's theory of gravity was a major advance, even though it was not perfect, and it still should be learned (it is still used for calculating lunar trajectories). In fact, maybe theories should be learned in historical order. It also means that for a

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[11]"Method or Madness?" In Cohen RS *et al.* (eds.): *Essays in Memory of Imre Lakatos*. Dordrecht, Holland: D. Reidel Publishing Company, 1976, pp. 457-504.

theory to be completely true, it must incorporate all the truth in every preceding theory. If we find a theory which adds new knowledge compared to its older predecessor but which fails to account for something which the old theory accounted for well, then the new theory is guaranteed to be incomplete, and in that area. Thus in one sense science is never provably right (and is very probably partly wrong), but in another sense it is always adding more truth as the models get more comprehensive and accurate.

One of the subjects that is not commonly dealt with adequately is the value of relative accuracy. Copernicus' theory was only marginally more accurate than Ptolemy's, but was still an advance, primarily because of its simplicity. Kepler's theory was much more accurate, and therefore an advance, even though it was slightly less simple and not completely accurate (and known to be so in Newton's time). Newton derived his gravitational predictions from models using successively fewer simplifying assumptions and becoming more and more accurate. Copernicus' model, Kepler's laws, and Newton's successive approximations got progressively closer to the way planets actually moved, and therefore may be considered progressively more accurate models. It seems unlikely to me that the models are not getting progressively closer to the actual model. This is especially true if one views Newton's model as Newton apparently did (he didn't know why it worked, just that it did) and not as some of his followers did who hypostatized Gravity. I think that Newton himself would have easily accepted Einstein's modification of his theory (and for all the discontinuity, there is a great deal of continuity).

For all the present hype about scientific fashions and contradictions, there is still a great deal of continuity in science. Perhaps the reason why this continuity in science is often missed by philosophers is partly because philosophy tends to concentrate on what is true and can be known to be true, which roughly coincides with pure science, rather than on what one should do, which roughly coincides with applied science or technology. A theory which involves major conceptual changes, like warped space-time fields, can make no noticeable difference for most applications.

Finally, since we do not require certainty, inductive arguments should be allowed back. After all, if something has happened a thousand times in one way, surely the reasonable first approximation is that it will happen the same way the next time. In fact, in one sense, all prediction has to be on the basis of induction. We do not know the future. We can only reason from the past.

This is one reason why the definition of science as the study of the reproducible makes the most sense.[12] If it is reproducible then one might expect a (fallible) principle of induction to be valid. Medical practice would not be possible without at least a partial application of this principle. For a study to be normative for practice, it has to be presumed that unstudied patients will react similarly to studied ones. This stance is in opposition to some Popperians.

This seems to me to be the best currently available theory of the scientific method. One of the things that both Murphy and I[13] are saying is that the web of interdependent theories does not just include science but also extends to theology, and indeed to any worthwhile intellectual endeavor, and some modification of the method of Lakatos should be used to decide between "research programs" in theology as well as science.

Thomas Kuhn does not like the idea of central theories. He prefers to refer to paradigms,[14] or exemplars and the disciplinary matrix.[15] This is because he does not see the central part of a science as expressed theories, but sometimes as less well-defined ways of looking at nature, particularly in their early phases. He notes that these ways of looking at nature are not changed in the scientific community with as much objectivity as you would expect by listening to scientists describe their method. Rather, the changes resemble some religious battles, with conversions and purges, and the new often supersedes the old as the old's adherents die out rather than everyone seeing the logic of the new position unforced. However, this seems to be a demonstration of the foibles of scientists, rather than a valid prescription for how science should be done. One can readily make the case that science would be farther along if scientists would act more like Lakatos (as modified by Musgrave) says they should (Kuhn

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[12]Another reason is that any position taken in science can be double-checked, thus providing an automatic curb to dishonesty of varying kinds, and also to bias. In many other fields one is relatively helpless against misleading information.

[13]And Lakatos—see note 10, p. 152 (n. 5).

[14]*The Structure of Scientific Revolutions.* Chicago, University of Chicago Press, 1962.

[15]*The Essential Tension.* Chicago, University of Chicago Press, 1977, pp. 293-319.

also sometimes overstates his evidence). It is also true that science advances when the central way of looking at things becomes more well-defined (*i. e.*, a theory).

Kuhn also seems to believe that there is no absolute truth. Rather, he feels that science is aimlessly evolutionary and happens to incorporate more solved puzzles by a kind of survival of the fittest theory.[16] He believes that "there is no standard higher than the assent of the relevant community."[17] However, in that case the whole meaning and motive for science would seem to disappear. For as he freely acknowledged, normal science is puzzle-solving, which presumes that there is a solution (that is, an absolute truth).[18] And paradigm shifts occur precisely when the old paradigm fails repeatedly to allow such a solution to one or more important puzzles and a new paradigm promises to deliver such a solution.[19] Often the proposer(s) of the new paradigm have to discount the judgment of the "relevant community", at least initially. There must be some higher standard to which they appeal. Kuhn also has trouble being consistent, noting that "the scientist after a revolution is still looking at the same world."[20]

It seems to me that many of Kuhn's observations on the lack of objectivity in science can be explained by the anomalous card experiment.[21] But this experiment was possible precisely because one could make a real card with a black 4 of hearts on it. That was objective reality, which anyone who had no psychological reason to deny it would recognize, at least when it was pointed out.

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[16]Note 14, pp. 169-173; compare p. 117.

[17]Note 14, p. 93.

[18]See Note 14, pp. 36-37

[19]Note 14, pp. 151-8

[20]Note 14, p. 128; compare p. 149. See also Shimony, A. "Comment on Two Epistemological Theses of Thomas Kuhn." In Cohen RS *et al.* (eds.), see note 11, pp. 569-88.

[21]Briefly described in note 12 pp. 62-64 and alluded to on pp. 111-4, quoting Brunner JS, Postman L: "On the perception of incongruity: a paradigm." *J Personality* 1949;18:206-23. People familiar with playing cards were shown cards with the color and suit mismatched. They at first forced the cards into the usual pigeonholes, sometimes without effort, then became confused by them, and finally some of them (but not all) figured out the mismatch. But the confusion could be quite profound and long-lasting. Kuhn does not mention that many subjects, rather than becoming confused, saw gradually more black in the black cards and more red in the red cards.

Perhaps our greatest problem with paradigms is that we tend to hold on to them by blind faith, instead of allowing faith to grow as the evidence for them accumulates, and always bearing in mind that our paradigms are not necessarily, or even usually, the ultimate reality.

I have even more trouble with Feyerabend's position that any rules for doing science are too restrictive. First, there is the logical problem. "There are no rules" is itself a rule, and thus self-contradictory. I can even use any rules I want under this program, as who is to say that my rules are any worse than someone else's rules or lack thereof? The argument seems to cut off the trunk of the tree where it is sitting. Second, there is the practical problem. It seems, if the history of science has anything to teach us, that there are rules that *are* helpful. One of them is, regardless of how attractive your theory is, you must make sure it is grounded in experience. That is the basis for science, and partly accounts for the rapid advance of science now as compared with the Middle Ages.[22] To say that sometimes people have lucked out breaking the rules is not the same as saying that it is a good idea to break them on a routine basis.

Science, in the end, is an attempt to align our philosophy to objective reality, so that our philosophy is, as much as possible, in accord with the way the universe actually runs. That is why science puts so much emphasis on experiment. However, it is also true that science has provided nearly coercive evidence that there is an underlying order to the universe which is at least partly comprehensible by us. It is thus reasonable to expect and search for further evidence of that order. And systematic search may very well be the best way to find that evidence.

Perhaps my own philosophy of science might be summed up as follows: I believe that there is an absolute truth, and that we can approximate it. I also believe that everything we do, and even that we perceive, is more or less fallible. That includes our application of methodological rules. Therefore there is no method that can give an ironclad guarantee of success. Perhaps we should

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[22]To see how different the outlook was then, note the Aristotelians' phrase "saving the phenomena", used for justifying the complications in the Ptolmaic system of astronomy, as if the phenomena needed to be saved rather than the theory (this is unbelieveable to the modern scientist who hasn't run across it before).

call our rules principles. I do not call them values unless they are distinguished from Kuhn's values, as they are not intended to be our own arbitrary creation but rather a (partial) recognition of an external reality.

Some of these principles are as follows: (A.) In general, the most obvious interpretation of sense experience is to be preferred. (B.) Observations are the court of final appeal. They are actually our only windows into the objective universe to see if our theories match reality. (C.) Inductive arguments, although not probative, are suggestive. (D.) Anomalies (or falsifications) should have more attention than most corroborating evidence. (E.) Novel facts should have more attention than anomalies, and in a psychologically charged enviornment novel facts that are collected in a blinded manner have the most corroborating value. (F.) One should always work with the best known version of a theory, especially an opposing one. (G.) Theories should either be logically connected and evaluated together, or else not be connected and be evaluated separately. (H.) Since all our theories (as well as our factual knowledge) are likely to be at least partially imperfect, the presence of anomalies should not cause us to immediately abandon a theory. A theory should not be abandoned completely until a better one can take its place. (I.) If two or more principles are more or less evenly balanced on opposite sides of an argument, withhold judgement unless you are forced to act (or the risks are minimal), then make your best guess and act accordingly.[23] In the meantime, try to see if you can resolve the dispute by collecting more data (in this case, it is a good idea to work in both research programs, and it can usually be done easily, contrary to Kuhn).

What I am proposing and attempting to explore partially is a theological research program, or paradigm, or central theory. I will thus pay particular attention to anomalies and crucial experiments, to continuity with previous theory, and to the prediction of novel facts by a given theory.

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[23]One of the striking things I have noticed about the history of science is that the truly great scientists seem to have an uncanny ability to sense which theories are more sound long before the evidence coerces everyone else. Some of this is due to selection bias (great scientists are those who worked on the right theories) but some seems to be due to a sense that is partly natural and partly developed.

I should make explicit something that has hopefully been implicit before. Science requires strict honesty. Fudging the data is the most heinous crime a professional scientist can commit. Ignoring evidence, particularly contrary evidence, is a close second. One is always expected to be objective. It is true that scientists often do not exemplify this virtue. But when they are caught they are severely punished, and rightly so. The standard is still absolute honesty.[24]

I should justify to some my omission of a possible role of the Holy Spirit at this point. It is not permissible to discuss this role unless we have established His existence and discussed some of His properties. This may make the discussion incomplete at this time. However, it does not necessarily make it fatally flawed becaues if He exists, and if He is impartial, then He will speak to anyone who will listen, even if the listener does not know all the details of Holy Spirit theology. Therefore it is fair to concentrate on the proper receptive attitude (open and honest) for now

One possible misconception should be cleared up. It is a half-truth that one may believe whatever one likes as long as one is sincere. Like all half-truths, it is dangerous. Honesty may indeed be the only important virtue. But honesty is not merely believing what one says, or even saying what one believes. Honesty is trying one's best to recognize external reality and to make one's statements correspond with that reality. So if one is honest one has to try one's best to perceive truth and believe that truth, and *then* to say what one believes. One's likes and dislikes should not have a determining influence on one's belief if one is trying to be honest (unless one is being honest about one's feelings). In fact, one should attempt to guard against possible bias introduced by one's feelings.

Properties of a Good Theory

The above is a largely abstract review of scientific methodology. At this point it may help to review some of the most salient properties of a good theory, with the help of some illustrations.

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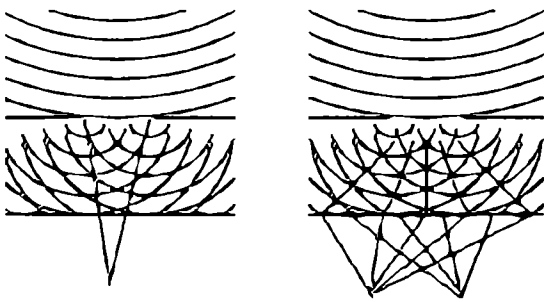
[24]In point of fact complete honesty is very difficult. Very probably none of us is completely honest about everything all the time. That does not change the fact that there are times at which we have the choice between being more honest or less honest. Good scientific method demands that at those times we choose the more honest alternative.

First, the primary purpose of any theory is to account for the facts. This applies to all theories, even ones suggested by Biblical writers. Theories are only useful for explaining or predicting facts.[25] To the extent that they succeed, they are good. To the extent that they fail, they are bad. It is not a requirement that a theory be easy to visualize. The only requirement is that the theory is logically consistent, that is, that one can make unambiguous predictions (and post-dictions) from it.

An illustration may help. The particle theory of light was popularized by Newton. This theory held that light was emitted like tiny bullets by an object like a candle or the Sun. It might be absorbed by, or bounce off of, other objects, and was sensed when it hit the eye. It predicted a finite speed for light, which proved to be correct. It explained reflection well, refraction not quite as well, and was superseded by the wave theory of light with the realization of the implications of interference. It was noted that light, upon going through two slits a short distance apart, would form bands of light and dark on a screen at certain intervals. These bands corresponded to areas where the wave theory predicted that light waves should reinforce or cancel each other (see illustration).



The illustrated slits are 3 wave lengths apart. Areas where the waves reinforce each other have lines drawn through them in the second illustration.

There was no plausible explanation for interference from the standpoint of the particle theory of light, and it was thus abandoned. The wave theory reigned supreme, explaining reflection,

[25]This is true on both a theoretical and a practical level. On a theoretical level, a scientific theory is primarily concerned with explaining the universe. But it must be the universe we live in, and therefore agreement with fact becomes critical. On a practical level, a scientific theory is primarily concerned with usefulness, that is, with being able to predict facts. But then it must predict the right facts (notice that we are specifically not saying that theories are merely collections of organized facts, but simply that their ultimate judge is facts).

refraction, and interference, until the discovery of the photoelectric effect,[26] which showed that light had some properties of particles which could not be explained by the wave theory. Thus the quantum theory of light was born. Quantum theory is very difficult to visualize; it is really a mathematical model. Explanations such as "wave packets" or "particles guided by waves" for quanta do not give a completely accurate picture. Quantum theory reigns in physics today, not because it is easy to visualize (quite the contrary!), but because it gives unambiguous predictions that have proven to be accurate. In order for another theory to supplant it, that theory must explain more facts.

In like manner, theories of, for example, the atonement are under obligation to explain facts. The Bible states, for example, that God is love, that sins can be forgiven, and that Jesus' death was not only necessary but planned. Any theory of the atonement must take such statements into account. The more such statements are adequately explained, the better such a theory is.

An important corollary to this way of looking at theories is this: Two theories (or doctrines) which predict the same set of facts are for practical purposes the same theory. If one cannot find, at least in principle, a situation in which the two theories make divergent predictions, then there is no meaningful difference between them. Thus, for example, for low speeds and masses there is no practical difference between Newtonian physics and the theory of relativity. For this reason, the theory of gravitation is commonly used to calculate the paths of objects in free fall, since the formulas are easier to use and they come up with, to within measurable error, the same values as those derived from the general theory of relativity. It it only when masses and speeds become large that noticeable differences arise and the theory of relativity shows its superiority.[27] The same should hold true for theological theories.

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[26]This was preceded by Planck's solution of the spectrum of emitted light which assumed that light behaved like it was emitted in packets. However, Planck apparently thought his solution was just a mathematical trick, and it was left to Einstein to make the proper generalization.

[27]A better (and at this point theoretically perfect) example is the difference between the subjective (Bohr) and objective (Bohm) interpretations of quantum mechanics. Both interpretations predict precisely the same phenomena, and are usually called interpretations rather than theories for this reason.

I once heard two people argue for weeks over whether justification and sanctification were two separate aspects of the same experience, or whether they were two different events which always happened simultaneously. On talking with the two people separately, it became evident that one was worried about the possibility of the other separating justification and sanctification temporally, while the other was worried about the first confusing the two, while each denied the other's charges. There would not appear to be any difference in the predicted results from these theories, and in that case, scientific theology would not recognize any essential difference between them.

Another important corollary is this: A theory which does not make unambiguous predictions which can be falsified is valueless. A useful theory, in the final analysis, is a way of saying, "Nature is put together in such a way that in a given situation where A or B could concievably happen, in point of fact, you will find A happening." If there is no such situation, then the theory is not testable, and it doesn't matter whether the theory is true or not. It cannot be used, which makes it useless. Scientific theology has little patience with arguments about how many angels can dance on the head of a pin.

In fact, other things being equal, the value of a theory is in direct proportion to its willingness to stick out its neck in testable ways. A theory which says that there is a certain kind of order in a part of the Bible, or the Qur'an, or human experience, is to be preferred to that which says that they are random, unless and until the theory of order has been shown not to match the facts.

So a good theory (or doctrine) should make unambiguous, falsifiable, and yet accurate predictions. But there is one other property a good theory should have. In science it is called elegance. This property is hard to describe, but one way to try is to say that elegance is the ability to describe many varied facts with just a few simple basic assumptions. The theory of gravity and Newton's laws of motion, for example, explained at one stroke the falling of objects to earth, the path of projectiles, the orbit of the moon, the earth, and the other planets, and ocean tides—quite a diverse array of natural events. But there is more to elegance than that. Maxwell, in 1909, was working on the interaction of magnetic and electrical forces in free space, and came up with 4 sets of equations. The fourth set contained zero on the right side, which

Maxwell's Equations:

I. $\frac{\partial E_x}{\partial x} + \frac{\partial E_y}{\partial y} + \frac{\partial E_z}{\partial z} = 0$

II. $\frac{\partial H_x}{\partial x} + \frac{\partial H_y}{\partial y} + \frac{\partial H_z}{\partial z} = 0$

III. $\frac{\partial E_z}{\partial y} - \frac{\partial E_y}{\partial z} = K_H \frac{\partial H_x}{\partial t}$

$\frac{\partial E_x}{\partial z} - \frac{\partial E_z}{\partial x} = K_H \frac{\partial H_y}{\partial t}$

$\frac{\partial E_y}{\partial x} - \frac{\partial E_x}{\partial y} = K_H \frac{\partial H_z}{\partial t}$

IV. $\frac{\partial H_z}{\partial y} - \frac{\partial H_y}{\partial z} = 0 \quad \left(= -K_E \frac{\partial E_x}{\partial t}\right)$

$\frac{\partial H_x}{\partial z} - \frac{\partial H_z}{\partial x} = 0 \quad \left(= -K_E \frac{\partial E_y}{\partial t}\right)$

$\frac{\partial H_y}{\partial x} - \frac{\partial H_x}{\partial y} = 0 \quad \left(= -K_E \frac{\partial E_z}{\partial t}\right)$

looked asymmetric compared to the other 3, so he invented a term to complete the symmetry. [28] This set of symmetrical equations led directly to the discovery of radio waves within a few decades and implied that they were related to light. The fact that elegance has turned out to be a useful property in scientific theory implies that the basic nature of the universe is built upon harmony. This has interesting implications for science and for theology.

Another important property of theories is their coherence with other, more well-established theories. In fact, one of the fundamental assumptions in science has been that all truth is interrelated. This is one reason one cannot train in chemistry without

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[28]The forms in the illustration are slightly modernized. The original equations can be found in Niven WD (ed): *The scientific papers of James Clerk Maxwell.* New York: Dover Publications, Inc., N. D. Equation 1 can be derived from equations 17 and 19 of *On Physical Lines of Force* (published in 1861) on p. 464, and also equation 115 on p. 497. Equation 2 can be derived from equations 57 and 58 on p. 476. The third set of equations are equivalent to equations 54 on p. 475. The fourth set of equations are equivalent to equations 15 on p. 464. The need to account for electric displacement "currents" is noted on pp. 496-7 (Prop. XIV), and formalized by the time *A Dynamical Theory of the Electromagnetic Field* appeared in 1864 (see equations C, A, and E on pp. 557, 554, and 560). The existence of waves whose speed equaled that of light was realized in the earlier paper (pp 499-500). This is particularly striking when it is realized that this theory required space to have a dielectric property, and seemed to require a material in a vacuum which was very stiff but allowed matter to pass without resistance (the famous "ether"), and which has since been discredited in the eyes of most scientists without destroying the validity of Maxwell's equations or his conclusions regarding the electromagnetic character of light.

knowing something about physics and vice versa. It is why too narrow subspecialization in science, while understood, is deplored. And it is why physicists are trying so hard to create a grand unified theory of the universe.

All of the above is not intended to say that there is no such thing as absolute theological truth. We will probably find in theology, as we have found in science, that the concept of absolute truth is a useful one. I personally believe in that concept (If I did not, I would not have written this book). The major reason for this tentative way of doing theology is that our perception of absolute truth is so often faulty, both from random error and from personal bias. The above method is an attempt to build self-correction into the theological process (For this reason I reserve the right to change my position if the evidence warrants).

There are Christians who say that such self-correction is insufficient, and that the human mind is so depraved that we can only accept God's word at face value. This position may be a nearly impregnable defensive one for a Christian. But Christianity is not intended to be primarily defensive: It is to take the offensive. In the words of Christ, "Go ye therefore and teach all nations, baptizing them . . ." (KJV) And when a Christian approaches someone who does not believe as he does, the unbeliever must first be convinced that the Bible is God's word, instead of the Vedas or the Qur'an or simply nothing at all outside of nature. Claims will not do. Joseph Smith also makes claims, which are contradictory to the Bible taken at face value, and they both can't be right. We have to have a way to choose between conflicting claims. What I am suggesting is that the claims which best fit in with what we otherwise know about the universe are the most credible.

Obviously, determining what best fits in with what we know about the universe is a big task. There will always be those who suggest shortcuts. But, as in science, the certainty of the conclusions is only as strong as the evidence behind them, and in the end, no shortcut will do the job as well as the proper way of investigation. I agree that our thought processes are far from perfect. But we must start from where we are. We cannot start with God's word unless we have good reason to believe that it is indeed God's word, and if that is the question, we must satisfy ourselves regarding the answer before we can proceed.

There is one more property of scientific theology that should be restated. It does not require one to have absolute certainty

before one can act. It follows the ethical guidelines long used in medical science: Choose the action which seems most likely to do the most good with the least risk of substantial harm. Sometimes, particularly in ambiguous situations, the best course is to collect and correlate more data in an effort to make the situation less ambiguous. But if the situation requires action, you must use your best judgment and then act.

This allows us to acknowledge strong points in an opposing argument, while not paralyzing us until all opposing arguments are answered. It will also leave us more open to the possibility that an opposing theory is actually better than our own. It thus encourages ethical activity without encouraging bigotry.

Because of this, in what follows I will not try to philosophically prove all the positions I take on various subjects. I believe theology, even more than science, is a subject too broad for any one mind, or even combination of minds, to fully encompass. It is impossible for anyone without the omniscience of God to write (or even understand) a truly comprehensive systematic theology. I will merely try to find the most reasonable models I can to explain the phenomena. You will then be able to make the judgment for yourself as to whether and how far I have succeeded. As Romans 14:5 says, "Let every man be fully persuaded in his own mind." [29]

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[29]Strictly speaking, I do not view this chapter as advocating the use of the scientific method in theology so much as advocating the use of a method honed on the study of reproducible events in the study of non-reproducible (by us) events. The method got its name from where it was developed, but what I am saying is that it is actually the method of knowledge and not just the method of science, and I am merely restoring it to its proper sphere.

Many theologians will recognize that this approach is not entirely new. In fact, they may even feel that they believe in most, if not all, of its basic tenets. Hopefully they are right. If it is good theology, someone before me may have seen it. The reasons for my presenting it are a) I haven't seen it put quite this overtly before, b) most conservatives (and because of my treatment of the data I consider myself a conservative) shy away from saying that theological statements in the Bible can be treated as models, and c) most theologians do not have the grasp of science necessary to treat the relationship between science and theology as carefully as I believe will be done here. They either tend to be overwhelmed by science, or to ignore it.

Some may also note that the term "scientific theology" has been used for a theology which has come to entirely different conclusions than I have. I believe that most of those theologians started from a philosophical base that refused to allow for any non-reproducible events, or even any events which could be caused by forces outside of nature. As we shall see in the next chapter, this is an unwarranted assumption given our present knowledge.

2

Nature

We have discussed the method of doing theology. Now we should discuss the materials. There are two basic ones: What we commonly call nature, and the supernatural. Many people consider nature to be the only reality, so we will discuss it first.

It is evident that most events display a certain amount of predictability, and that the more closely we investigate, the better that predictability becomes. Simple systems, like those in physics experiments (the most predictable), more complex ones like chemical or biological systems, and finally psychological systems, all appear to follow well-defined laws. It is generally assumed that large, complex, relatively unpredictable systems like geological and meteorological ones are difficult to analyze mainly because of their complexity, and will become more predictable when we know more about them. This assumption is gradually being borne out. In short, the natural world is built upon order.

The fact is that the existence of science argues strongly for an

ordering principle in the universe, which we may call God[1], and which we may at least partly comprehend. To argue otherwise is, quite frankly, absurd, and those who do so do not believe their own rhetoric. You don't catch them fasting for prolonged periods in the belief that this time nature will not require food as usual, or chaining themselves to the ground in case they should no longer be attracted to the earth. I find the case against the existence of God very weak indeed. The first thing we can learn from nature is that the universe is orderly, and requires an ordering principle.

The success of science has been used to support arguments for two different theologies which deny the possibility of the supernatural. In theory they are exact opposites. To use theological terms, in one God is completely immanent, and in the other He is completely transcendent. That is, in one system (pantheism) the ordering principle of the universe is inherent in, and inseparable from, nature itself. Scientific materialism is a form of pantheism. In the other (deism) the ordering principle is totally separate from the universe, and having once started it going, has allowed it to run on its own without any outside interference.

In theory these two views are distinct, but I know of only one way to distinguish between the phenomena they predict, which we will come to shortly and which has little impact on our lives now. It does not really matter whether the ordering principle is part of nature or separate from nature, if in fact you cannot observe anything other than nature. Therein lies both the attraction and the difficulty with both systems. The systems have a certain simplicity which is one element of elegance: All phenom-

[1]I think this is the most natural definition of God. This definition would account for the use of the word God by many scientists (including Einstein). Notice that the definition does not presume a God Who deserves worship, a personal God, a God who takes cognizance of us, or even a single God, although of course it includes such a God. The position of scientific materialism, or scientism, is that the ordering power or principle of the universe takes no notice of our thought processes except insofar as they influence the atoms and ions in our brains. There is still an ordering power of the universe. Thus scientism has a god. However, since that god is indistinguishable from the universe and takes no direct notice of us, for practical purposes scientism may be said to be atheistic.

The distinction between an ordering principle and an ordering power is easy to make in the case of an automobile or computer, but becomes more difficult to visualize at the atomic level, and probably ceases to exist at the subatomic level.

ena can be explained by natural law alone. It cannot be denied that a similar premise has done much to advance science. Pantheism is the simpler of the two, and because of this, has often been the preferred model for what may be called empiric naturalism, the belief that the universe is run by laws that do not take factors other than physical ones into account and do not change.[2]

However, there are certain facts which cannot fit into empiric naturalism. These facts come from the core of disciplines like cosmology, atomic physics, and biochemistry. I will outline the facts below. They are surprisingly coercive. Therefore it is more reasonable to believe in a God Who changes the natural order of things on occasion than it is to believe in one who cannot or will not. Agreement with the facts takes precedence over any other property of a theory.

The Big Bang

The first subject we will discuss has to do with the only difference between pantheism and deism. Pantheism (often called atheism)[3] insists that the material of the universe is itself the ordering power that creates the order that we see. It is thus forced to conclude that matter is eternal, because if there was a time before which matter did not exist, then it could not always be the cause of itself. Deism will admit to the possibility of a God who got matter started in the first place.

For one who wants a simple picture of the universe, pantheism is the most attractive option. For some time it appeared to be the majority position of scientists, and indeed it may have been. But lately it has been all but abandoned by physicists and astronomers, largely because of the Big Bang theory. This startling development deserves some review.

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[2]There are a number of theologies or philosophies which have empiric naturalism as part of their foundation. There is, of course, scientific materialism, but there is also the idealism of Kant and that of Hegel, as well as Marxism and the scepticism of Hume and the pantheism of Spinoza. Some of these philosophies would vigorously protest being confused with scientific materialism. However, in terms of the predictions they make about phenomena, there is little or no difference between them, and therefore scientific theology is justified in considering them together.

[3]Although I believe that technically this is a misnomer for reasons outlined in note 1 above.

Since the days of Galileo and Copernicus, scientists have become increasingly aware that the universe appears to be huge. First, the size of the solar system was accurately measured. Then the shift of nearby stars against more distant background stars between summer and winter (or spring and fall) was measured, and their distance from the solar system calculated on the basis of the angles they formed with the earth's orbit around the sun. Then most of these stars were observed to form a pattern, called the main sequence, when their presumed actual brightness (calculated from their apparent brightness and their presumed distance from Earth) was plotted against their temperature as determined by their spectra. The Milky Way was noted to be made up of stars, presumably at great distances from us. Then other galaxies were noted to be made up of millions of stars as well. Some stars, called Cepheid variables, were found to pulsate at a regular rate that was proportional to their absolute brightness (this was first noted on the Magellanic clouds, where all the stars are the same distance away for practical purposes). The absolute brightness of Cepheid variables was determined statistically using their radial motions (by doppler measurements), their proper motions, and their apparent brightness. Finally, if Cepheid variables and main sequence stars were assumed to have the same absolute brightness in other galaxies, scientists could calculate how far away these galaxies were, and the boundaries of the visible universe were pushed back billions of light-years.

Scientists were interested in which way all these stars were moving. Lateral motion was hard to determine, but movement toward or away from us was relatively easy to determine. If a star was moving toward us, its light would have a higher frequency than expected. The blue would turn to violet or ultraviolet, the red would turn to orange or yellow, and the infrared would turn to red, depending on the speed of the star toward us. The reverse would happen if the star was moving away from us (it is the same principle that causes train whistles to seem higher in pitch when they are approaching and lower when they are receding from us). By itself this change could not be accurately observed, but if there were special dark (absorption) or light (emission) lines in the spectrum, caused by different elements like hydrogen or calcium in the star's gases, these lines would also be shifted and their shifts could be measured. If they shifted toward

the violet, the star was approaching us. If they shifted toward the red, the star was receding.

When Doppler measurements were made on galaxies, an astronomer named Slipher noted that a number of galaxies seemed to be receding from us at rates up to two million miles an hour. Edwin Hubble systematically catalogued galaxies according to their brightness, and therefore rough distance from us, and noted that they were nearly all receding from us, and that their light was shifted more toward the red the further away they were. He proposed Hubble's law, which stated that the further away a galaxy is, the faster it is moving away from us and thus the more its light is shifted toward the red. In spite of initial resistance from the scientific community, this law has now been accepted. The universe is now generally conceded to be expanding.

This led to two different explanations for the universe, the Big Bang theory and the Steady State theory. It turned out that galaxies were spread nearly equally in all directions, except where the Milky Way obscured them. We had already been proven not to be at the center of the earth, the solar system, or even our galaxy, so neither model was willing to say that we are at the center of the universe. One model of the universe said that it should always look the same from everywhere and at all times (the "perfect cosmological principle"). This required that galaxies be created to fill in the gaps between other galaxies as they moved apart. It also implied that we should see burned- out galaxies which were much older than ours, just as our galaxy would eventually be burned out and be viewed by possible observers on other galaxies. Finally, no matter how far you looked, all galaxies must look pretty much the same.

This model had one disconcerting feature. Matter must be continually created out of nothing in order to keep the model viable. There was nothing to keep an earth, for example, from being created out of nothing. This was very uncomfortable for scientists who didn't want an outside God meddling with the universe. They solved this by proclaiming that newly created matter had to be put into the universe as hydrogen, and evenly spaced (it does not take much hydrogen—only one thousand atoms per cubic kilometer, or 4200 per cubic mile, per year—far too small to measure).

But the steady state theory has largely been abandoned, and for three reasons. First, and weakest, the galaxies furthest away

from us (and therefore further back in time) seem to have slightly more of a red shift than you would expect from their apparent distance. That is, the galaxies furthest away from us seemed to be receding faster. This was contrary to the perfect cosmological principle and therefore the steady state theory, but in accord with the Big Bang theory which predicted a faster expansion earlier (before gravity had a chance to slow it down). Second, there was the discovery of radio galaxies and quasars. These objects did not compare with anything closer to us. Although they were not predicted by the Big Bang theory, they are compatible with it, but not with the perfect cosmological principle. Finally, the Big Bang theory predicted the existence of radiation from the original Big Bang, red-shifted to the microwave range, which was independently discovered by two radio astronomers named Penzias and Wilson. There was no way to account for this background radiation using the steady state model.[4]

So at this time the Big Bang theory reigns supreme.[5] But this means that the universe had a beginning, and there is no way to get back before that time. Matter is not eternal. At the maximum it was created about 19 billion years ago, and we cannot make even an educated guess about what happened before. Furthermore, the laws of physics break down at that point, for the natural prediction we would make of the universe is that at the instant of its creation, if it did start as a point, it should have turned into what is known in astronomy as a black hole, with too much gravitational pull for even light to escape.

Perhaps the best attempt to explain how the universe could have been created without violating the law of gravity (or more accurately general relativity) has been done by Stephen Hawking.[6] He postulates that the universe is unbounded when viewed in terms of space and imaginary time (time multiplied by the

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[4]A good non-technical survey of the relevant information and concepts can be found in Asimov I: *The Universe: From Flat Earth to Quasar.* New York: Walker and Company, 1966.

[5]The concept of an initial uniform expansion has recently come under fire, and some may misinterpret this to mean that the Big Bang is in trouble. In one sense it is, as the Big Bang cannot easily account at present for a "lumpy" universe, but in another sense it is not, as projecting the positions of galaxies backward in time still leads to a point.

[6]Outlined in *A Brief History of Time.* New York: Bantam Books, 1988.

square root of -1). Perhaps in the first few seconds of the universe matter that was created was counterbalanced by the negative energy of gravitational fields, so all of it need not be present at the very beginning. But his analogy breaks down if the universe does not eventually contract again in a Big Crunch, which it appears that it will not do (there doesn't appear to be enough matter to reverse the expansion of the universe by gravity). He also does not explain why another universe should not appear suddenly in the same way. And this still leaves a beginning in real time. We are still left with the fact that the universe did not start itself. Something else started it. There is not an unbroken chain of cause and effect involving matter. The simplest solution is that what started it is the same entity that keeps it organized, namely God.

Many scientists have been very uncomfortable with this conclusion, and have seemed to have reacted from their hearts rather than from their heads, as documented by Robert Jastrow (himself an agnostic) in *God and the Astronomers*.[7] One usually thinks of scientists as pursuing knowledge without regard to emotion. But this is not the case. Scientists have emotions like everyone else. And in this case, as Jastrow notes on p. 116, "For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to scale the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries." No wonder scientists are upset.

So the second thing that we can learn from nature is that it was created, in all probability by the God who gives it order. Pantheism will not do. We have at least to be deists if we are to follow the evidence.

Quantum Mechanics

But it turns out we cannot even be pure deists. We must accept the fact that God did not merely set the universe in motion and leave it to run on its own. He is actively coordinating what goes on now. For quantum theory (and experimental evidence) is incompatible with a universe where particles merely react with one another.

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[7]New York: W. W. Norton and Company, Inc., 1978.

The usual picture of the universe given by believers in scientism was objective, and thus the same to all observers, completely regular and thus predictable if part of it is known, and in which information can only travel by particles and perturbations of those particles which are limited to the speed of light. The last condition is a requirement if no effects exist that are caused by something outside of nature. This picture is incompatible with quantum theory. And some of the experiments to test whether quantum theory or this kind of a universe explains nature better have been done, and the results have confirmed quantum theory.[8] Thus Someone is rigging the experiments. The rattling of atoms is simply inadequate to account for the universe. What is known in physics as naïve realism is dead.

It is hard for us who live in a society which is so thoroughly dominated by a scientific viewpoint to realize that the metaphor of the universe as a complicated piece of machinery has had to be abandoned. But that is precisely what has happened, in spite of (and partly because of) the best efforts of Einstein. Perhaps it will help to review some of the history and a few of the more critical experiments.

In 1900 Max Planck noted that light behaved as if it was emitted in packets with energy E given by the equation $E=hf$, where h is a constant chosen to account for the fact (unaccountable for in classical physics) that hot objects glow red at cooler temperatures and glow white at hotter temperatures, and f is the classical frequency. In 1905 (the same year he proposed the theory of special relativity and published a way to prove the existence of atoms by Brownian motion), Einstein published a paper explaining the photoelectric effect by the theory that light could only be absorbed in these same packets, or quanta. This idea was further strengthened by Arthur Compton who showed that light could scatter electrons as if it were made up of particles with momentum $\pi=hk$, where k is the number of wavelengths per unit length.[9] Then Louis de Broglie proposed that

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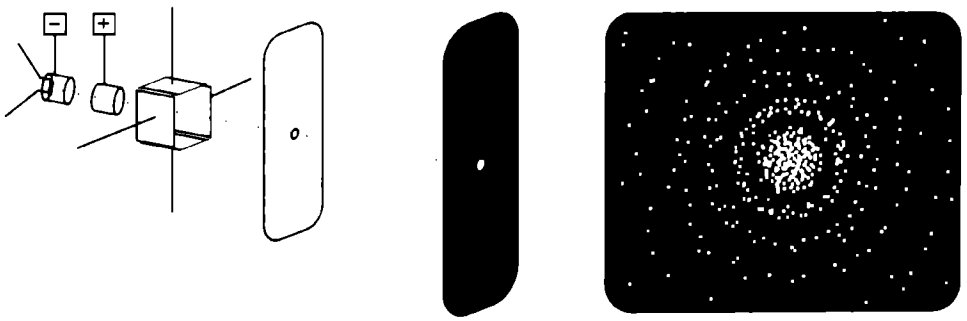
[8]For those wanting to look at most of the original papers, they are conveniently collected in Wheeler JA, Zurek WH, eds: *Quantum Theory and Measurement.* Princeton, Princeton University press, 1983. A more popular treatment may be found in Herbert N: *Quantum Reality.* Garden City, NY: Anchor Press, 1985, or Casti JL: *Paradigms Lost: Images of Man in the Mirror of Science.* New York: William Morrow and Co., 1989.

[9]Related to f by the equation $k=f/c$, where c is the speed of light.

matter, such as electrons and atomic nuclei, also had wave properties when moving. This was also confirmed by experiment. A simple model of the atom was proposed by Neils Bohr using quantum theory, and it successfully predicted the hydrogen emission and absorbtion spectra. Then several different mathematical descriptions of the behavior of quanta (quantum mechanics) were discovered, and since then the theory has been extended ever farther without once having been proved wrong.

But that does not mean it has not proved strange. For example, take a black and white television screen. This is made up of a source of electrons (a hot negatively charged wire), some hollow metal cylinders which are charged so as to accelerate the electrons, some deflectors to aim the beam, and a screen which lights up each time it is struck by an electron. Now let us ignore the deflectors and instead aim our beam at a plate with a hole in it. At first the beam goes right through the hole without noticeable change and makes a bright spot on the screen. Then if we make the hole smaller the bright spot grows smaller, as stray electrons are blocked. But as the hole is made still smaller, something strange happens. The bright spot starts to enlarge in a peculiar way. It makes a pattern of concentric rings, called an Airy pattern (named after George Airy who first described it in 1835).



Cathode Ray (TV) Tube Airy Pattern

This pattern is characteristic of a wave. The dark rings are areas of destructive interference and the light rings are areas of constructive interference. Looking at this pattern we are tempted to think of the electrons as waves. If we make the hole smaller yet, the central spot enlarges until a soft glow covers the entire screen. Then the glow dims, then we can see individual flashes, then the screen goes dark.

But now let us enlarge the hole again until we have our Airy pattern, then turn the beam intensity down. If we look at the screen we can see individual flashes of light, more in the center and less at the edges, and practically none in the dark rings. Here we can see the individual electrons as they arrive. But they act like they are guided by waves. Perhaps, we think, the waves are like sound waves, dependent on large numbers of particles. So we turn down the intensity until we see a flash here, then another one there, seemingly scattered randomly across the screen. We adjust the screen so that only about one flash a minute gets through. That should take care of any effect that takes large numbers of particles. Then we put some photographic film right next to the screen, and go away and leave the apparatus for a week. When we come back we develop the film and guess what! We have an Airy pattern.

This experiment illustrates several facets of quantum theory. First, very small objects which are indisputably particles have attributes usually attributed to waves.[10] Second, when it is travelling, the wave properties of a quantum object predominate, whereas when it is detected, the particle aspect predominates. Somewhere, apparently at the surface of the phosphor, the wave suddenly collapses into essentially a point. This collapse forms our first problem in quantum theory interpretation. How can a wave collapse into a point? Or was it a point all along, merely guided by a wave? Finally, the angle of the Airy pattern bullseye has an inverse relationship to the size of the hole, so that the uncertainty in sidewise motion times the diameter of the hole in electron "wavelengths" (the uncertainty in position of the electrons at the start) roughly equals Planck's constant h. This inability to measure certain attributes (called conjugate attributes) simultaneously to any desired accuracy forms our second problem. Do such attributes exist and we simply cannot measure them, or do they not even exist?

A second set of experiments might be called the ghost pathway experiment. We can set up a half-silvered mirror at a 45° angle to a beam of light. This splits the beam into two roughly equal beams, one going to mirror B and one to mirror C. These

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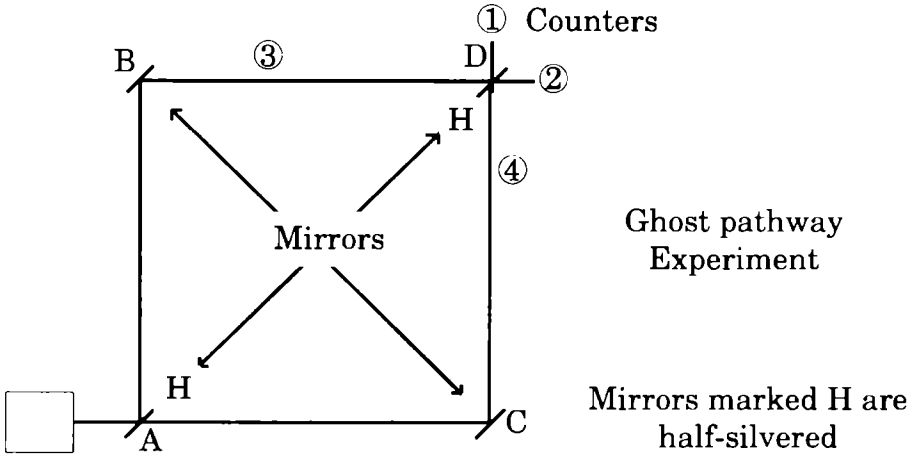
[10]The converse is also true. We could have performed a similar experiment with light. In fact, the Airy pattern was originally used to prove that light was made up of waves. Yet light behaves like particles when it is sent and received.

beams can then be reflected toward mirror D which is also half-silvered, and they will interfere with each other. In this particular case they will both join to strike counter 1 (A slight adjustment of the mirrors will cause them to strike counter 2).



Now we will again decrease the light intensity until we have only one photon at a time go through. We may arrange, say, one count per minute. It will still always strike counter 1. Even if we use a special light source with a single fluorescent atom so that we know that there can be only one photon at a time, we will still get this interference and the photon will only hit counter 1.

Now if we put an object in either of the pathways, we will get counts in both counters 1 and 2. If the object in the pathway is a counter (say counter 3 in the pathway from mirror C to mirror D), we will get two counts in counter 3 and one count in counter 2 for every count in counter 1, on the average. The same thing happens if we put counter 4 in the B-D pathway. In this part of the experiment the photon behaves as if it were a little particle (or wave packet) which takes one or the other pathway. But if we keep counters 3 and 4 out of the way, all the photons again go to counter 1, as if they knew somehow that both paths were open to them. If we think of a photon as a wave packet, how does the photon know that the path it didn't take (which may be 3 feet or 3 miles away) was open? Or if we think of the photon as a wave, why is it not counted roughly simultaneously in, say, counters 4 and 1 or 2?

Some of you are tempted to shake your heads and say, "This must be science fiction." I am sorry, but the above experiments

are sober fact. Others may ask, "How can it be this way?" The answer is, nobody knows. There are mathematical models which successfully predict the results of this experiment. But no one that I know of has been able to postulate a model that we can visualize and that still turns out to explain the data.

But we are only warming up. Suppose we take the mirror D out of our apparatus (and leave counters 3 and 4 out). Then half of the photons will go to counter 1 and half will go to counter 2. If our apparatus is sufficiently large (or we are able to move the mirror fast enough), we can actually decide after the photon is in our apparatus whether it will act as if it traveled both pathways (and always is counted in counter 1), or whether it will act as if it traveled only one pathway (and strikes counters 1 and 2 with equal frequency but not simultaneously). That is, in a manner of speaking, our actions now will determine what happened in the past.[11]

Most of us grew up in an environment where science was thought to have nearly reduced everything to particles moving in gravitational and electromagnetic fields: Science could reasonably be expected to complete that reduction (except for miracles for those who believed in them) in the near future. But if one listens to quantum physicists one hears weird statements like "There is no deep reality" or "The observational act determines reality" or "The moon isn't really there unless you look at it" or "Consciousness determines reality". At first we are tempted to dismiss such statements as those of some crazy people or embittered anti-scientific philosophers. But these are Nobel prize winners in science. And the reason why they are saying such things is that they are trying to make sense of the most scientific discipline of them all.

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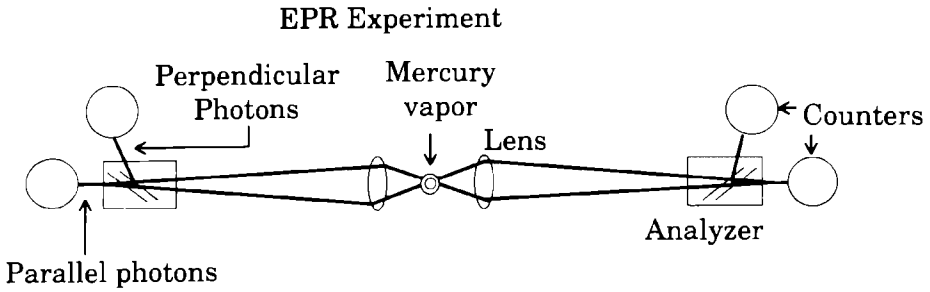
[11]See, for example, Alley CO, Jakubowicz O, Sleggerds CA, Wickes WC. "A Delayed Random Choice Quantum Mechanics Experiment With Light Quanta." In Kamafuchi S *et al.*, (eds.,) *Proceedings of the International Symposium: Foundations of Quantum Mechanics in the Light of New Technology, Tokyo, 1983.* Tokyo, Physical Society of Japan, 1984, pp. 158-64, Alley CO, Jakubowicz O, Wickes WC. "Results of the Delayed Random Choice Quantum Mechanics Experiment With Light Quanta and Proposal of a New Type of EPR Experiment Using Light Quanta Produced by a Nonlinear Optical Process." In Namiki M *et al.*, (eds.), *Proceedings of the 2nd International Symposium: Foundations of Quantum Mechanics in the Light of New Technology*. Tokyo, Physical Society of Japan, 1987, pp. 36-52, and Schleich W, Walther H. "Single-Atom and Single-Photon Experiments." In Namiki M *et al.*, *ibid.*, pp. 25-35.

There are other strange aspects of quantum theory. Some photons behave like they came from the entire surface of a star, which may be more than 100 million miles across (this effect is used in stellar interferometry. It cannot simply be two photons interfering, or the phase relationship would be inconstant and therefore the interference pattern would be lost), and the photons may be hundreds of feet wide or even more. And some photons should interfere with themselves even though the two pathways they traveled mean that the two parts of the interfering photons are separated by millions of light-years.

The next set of experiments we will review was suggested by Einstein and two of his colleagues, Boris Podolsky and Nathan Rosen, in 1935. Einstein was profoundly unhappy with Neils Bohr's interpretation of quantum mechanics, which came to be thought of as the orthodox interpretation. It stated that objects like electrons and photons did not really have attributes like position, momentum, or energy, but only probable ranges. Quantum theory was interpreted as a description of probability waves, and quantum objects had no more reality than that. Thus, where an electron struck a screen was determined by chance, almost like rolling dice (actually the dice are more deterministic—if we knew their speed, rotation, distance above the table, and the hardness and resiliency of the table more accurately we could probably predict the value the dice would give more accurately. We cannot predict the position a given electron will show on a screen any more accurately than the probability wave, no matter how hard we try).

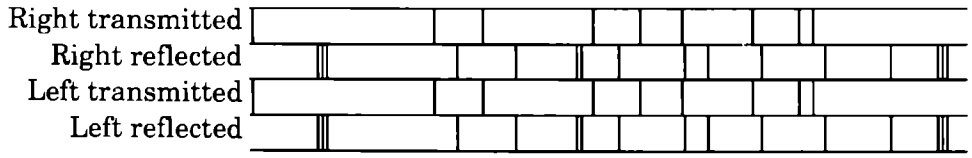
As Einstein stated, "I cannot believe that God plays dice with the universe." He spent a great deal of time trying to construct idealized experiments (or "thought experiments") which would prove that conjugate variables such as position and momentum, or energy and time, could be measured simultaneously to an arbitrary accuracy (or at least less than h for their product). He failed every time. Finally he proposed that there had to be "hidden variables" which perhaps could not be measured, but which would give the "real" position, momentum, etc. of a quantum object. He and his two colleagues stated that if you knew something would be true about a system before you measured it, then it must be real. They noted that if two quantum objects (protons, electrons, photons, etc.) were brought in very close proximity and then allowed to separate, a property called spin axis would al-

ways be found to be pointed in opposite directions on the two particles when measured. Thus they felt that these objects had to have real spin axes that were simply unknown at the beginning of the experiment.



An example may help. If a mercury atom is excited properly, it will give off two photons nearly simultaneously, in opposite directions. These photons can have their polarizations measured by passing them through clear glass plates set at an angle. The light which is polarized in the plane of the angle is allowed to pass through, and the light which is polarized perpendicular to this angle is reflected. One may then put counters behind the polarizers, and count the photons which make it through the polarizers. To make things clearer, we will also count the photons which are reflected from the plates.

If we set up the experimental apparatus shown in the diagram, according to quantum theory, each pair of photons given off by a mercury atom will have opposite spins, 180 degrees apart. That means they will appear to have the same polarization to our analyzer (The analyzer cannot tell the difference between "up" and "down" photons. Both register as "vertical"). So if we run a tape of our counters we might see a recording as follows:



or

Right	T R R R T R T R R R T R T T R R T R T T R R R R R . . . .
Left	T R R R T R T R R R T R T T R R T R T T R R R R R . . . .

(T = transmitted, R = reflected)

Notice that the first and third rows exactly match, as do the second and fourth rows. Thus the transmitted and reflected pho-

tons match. That is, each pair of photons is oriented in the same plane.

The conventional interpretation of quantum theory said that an unpolarized photon "decides" at the polarizing device, in a random manner, which way it will be polarized. Einstein said no: The photon is actually already polarized, and the polarizing device merely reveals the direction of its pre-existing polarization. He said that otherwise we could not explain why our 2 photons were polarized in parallel, because the measurements are done independently, and signals from one measurement, travelling at the speed of light, can't influence the other measurement.

The Einstein-Podolsky-Rosen (or EPR) experiment was the last gasp of what is now called naïve realism. The arguments from the experiment have been completely nullified, and in fact reversed. But before we see how that happened, we should first note the relationship between naïve realism and the idea of causality.

The idea of causality is instinctive to humans. A footprint is found; something must have caused it. A ripple is seen on a lake; something must have disturbed the water. A man gets sick; something must have made him sick. A woman has a baby; something must have caused her to have a baby.

The first two examples are rather straightforward. With experience and careful observation we can determine the causes of the footprint and the ripple, with a high degree of agreement between experts, and of experts with previous observers of the events. Biology and chemistry, on the other hand, do not lend themselves to analysis so easily. The role of sexual intercourse in causing childbirth is not obvious unless someone points it out. The results come much later, the cause is not usually seen in public, and the results do not always follow the cause. As a result, some societies have not discovered (or have lost) the idea of the connection between the two. In these societies, however, children are thought of as having some other cause.

For disease, the picture is even more complex. There are multiple real causes of disease, many of them either microbes which can't be seen, or emotions which can't be found physically and which may be explicitly denied. Thus the causes the ancients gave for disease were many, all the way from bad air (in Latin mal aria) to demons to punishment from God. Some things did make sense: Syphilis was caused by sexual intercourse by someone

who had it, Plague was caused by proximity to someone who had it, poison can kill, and living around swamps was unhealthy. As swamps were drained and the number of new malaria cases went down, we could see the emergence of a primitive science and technology.

Science entered the picture in a big way with the work of Isaac Newton. He postulated his famous laws of motion. 1. A body tends to continue both its speed and direction of motion (or remain at rest) unless acted on by an extrinsic force. 2. Any change in speed or direction of motion is proportional to the force applied and inversely proportional to the mass of the object 3. For every force exerted by one object on another, there was an opposite but otherwise equal force exerted by the second object on the first. Then he postulated the law of gravity. Each mass exerts an attractive force on every other mass proportional to the product of the masses and inversely proportional to the square of the distance between them. Suddenly, the motion of objects could be accounted for using only the direct pushes and pulls they gave to each other, and this mysterious force called gravity, about which Newton said, "I frame no hypotheses."

The kinetic theory of matter further extended this picture to liquids and gases. Chemistry was soon absorbed into this system. Biochemistry followed suit, and more and more biologists assumed that biology would also soon be explained, along with behavioral science. Electricity, then magnetism required the introduction of fields, but these were fairly easily incorporated into the mechanical view of the universe, and in fact pointed the way to a solution to the mysterious gravitational field, in the form of Einstein's theory of general relativity. At this point the triumph of the mechanical view of the universe seemed complete, with only mopping-up exercises left to do.

Implicit in this view is the idea of cause and effect. A force is applied, so an object (be it an electron, an atom, an arm, a car, or the moon) changes its motion. Implicit also is the idea of time. An object cannot change its motion before the force is applied. Cause always comes before effect in time.

Thus when Einstein presented his theory of special relativity, it caused great consternation, partly because the theory held that for what used to be considered simultaneous events widely separated in space, the words "before" and "after" were meaningless in an absolute sense. Which event was first depended on

which way you were travelling, and how fast. This would destroy the possibility of instantaneous action at a distance, on which the theory of gravitation rested. Physicists found this idea very distasteful, but were forced to swallow it by the logic of the theory of relativity and its close fit with observations.

In the place of the usual concept of simultaneity as the absolute boundary between cause and effect, special relativity introduced the concept of the "absolute elsewhere". Briefly, the speed of light in a vacuum is the absolute speed limit of the universe. If light from one event has time to reach another, then the first event is in the "absolute past" of the second, and the second event is in the "absolute future" of the first, and the first event can (partly or completely) cause the second event, but not vice versa. All observers will agree on which event is first. However, if the events are close enough in time and far enough apart so that light from either event cannot reach the other before it occurs, then the events are in each other's "absolute elsewhere". Neither event can cause the other. Therefore, even though observers travelling at different velocities may disagree on which event happened first, no one would argue that something which happened second caused something which happened first.

It might also be observed that since nothing except light can travel the speed of light, time must always travel forwards for any ordinary object. This includes people. Thus there are limits to the warping of time with special relativity, and for ordinary purposes time can be considered an independent variable just as Newton considered it.

Note that Einstein's interpretation of the EPR experiment is heavily dependent on this idea of the absolute elsewhere. If the two photons (or protons or whatever) are measured, then the only ways they can match each other are if one' measurement caused the other's measurement, or if they both had a real property which was merely revealed by the device. If they are measured in each other's absolute elsewhere and they still match, then there must be some kind of real property that they share.

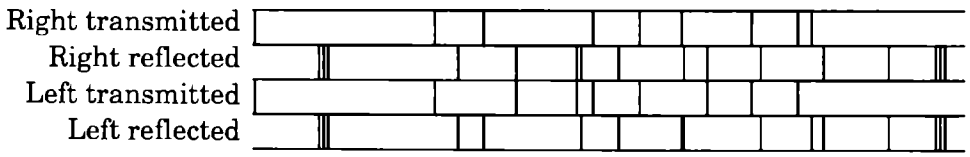
The downfall of naïve realism started when Niels Bohr showed that the orthodox view of quantum theory could account for the EPR experiment, although the traditional idea of causality had to be sacrificed. It was helped along by David Bohm, who finally developed a theory in which each particle (electron, proton, photon, etc.) had a definite position and momentum, but was influ-

enced by the measuring device in such a way that the particle exactly imitated quantum theory. This theory had long been a goal of Einstein, but had been thought to be impossible. The problem with the theory was that it required the particles to sense changes in the measuring devices at speeds greater than that of light, thus solving quantum theory "in the way Einstein would have liked least."

Finally, John Bell proposed a mathematical model which made certain requirements for naïve realism, which conflicted with the predictions of quantum theory. These have been tested, and quantum theory has been vindicated. The concept is simple enough, and important enough, that we will again use an example.

Suppose we take our EPR apparatus and turn one of the analyzers on its axis, so that instead of lying in the plane of the paper the "perpendicular" photons now lie in a plane at some angle to the paper. If the angle is 90°, the functions of the counters are simply reversed, and we have another version of the original EPR apparatus. But if the angle is less, we have a situation where some of the photons will match one way and some will match the other. And we can say something about the way they match.

If Einstein is correct, and each photon has a "real" spin, then if we turn one analyzer through a small enough angle, we might see a record in which, say, 25% of the records do not match. So the record might look like this:

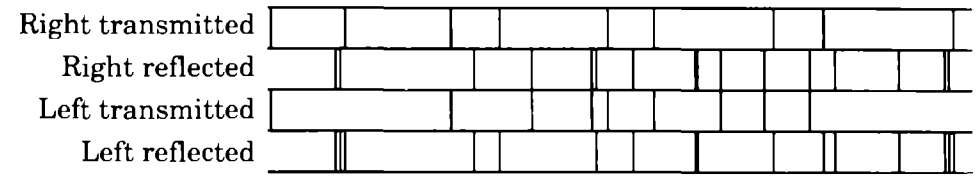


or

Right	T R R R T R [T] [R] [R] R T R T [T] R [R] T R T [T] R R R R R . . . .
Left	T R R R T R [R] [T] [T] R T R T [R] R [T] T R T [R] R R R R R . . . .

(T = transmitted, R = reflected)

We do not know yet what angle this is, but it does stand to reason that it does not matter which analyzer we turn, or which way we turn it. And indeed the experimental evidence agrees with this expectation. In our example above, we have turned the left analyzer.



Or

Right	T R R T T R T R R R T R T R R R T R R R T R T R R R R T . . . .
Middle	T R R R T R T R R R T R T T R R T R T T R R R R R . . . .
Left	T R R R T R R T T R T R T R R T T R T R R R R R . . . .

Now suppose we turn the left analyzer as above, and then turn the right analyzer the opposite way. If photons have a real orientation in space, then we would expect that the two analyzers would disagree from a theoretical "middle" analyzer with the same frequency, so the maximum disagreement they can have with each other is 25% + 25% or 50%. They could disagree with each other less, as there might be some photon pairs for which both analyzers disagreed with the theoretical "middle" analyzer (like the pair in the double box) and therefore matched each other again. But they couldn't disagree with each other more than 50%. By a similar line of reasoning it can be shown that the disagreement at any given angle should be greater than or equal to half the disagreement at twice that angle (in actuality, I have been slightly inaccurate in running the same precise experiment over three times. There should be three different sequences. But the above arrangement makes it easier to understand the kinds of consequences expected).

Quantum theory, on the other hand, has a straightforward prediction for what the match for a given angle should be. In this situation it is $\cos^2 \theta$, where θ is the angle one analyzer makes with the other (regardless of which analyzer moved—or whether both of them did). Thus at an angle of 30° there should be a 25% disagreement between the two analyzers, and at 60° there should be a 75% disagreement (the worst violation of Bell's Theorem is actually at 67° and 23°, but the disagreement exists for every angle except 45°). This clearly violates the conditions required by any theory of localized reality. Quantum theory is incompatible with any local real theory of the universe.

As you might expect, several scientists have tried this experiment with various refinements. The results are compatible with

quantum theory, and extremely unlikely to be compatible with the requirements of local real theories. They even switched the angles of the analyzers while the photons were in flight and the statistics still agreed with quantum theory and disagreed with classical theory. Strictly speaking, the above experiments are statistical, and there is perhaps a billionth chance that they could have come out that way by the luck of the draw, but no physicist that I know of is betting on it. And there is another thought experiment I know where local reality and quantum theory are diametrically opposed,[12] and although the experiment has not been done yet, physicists are not holding their breath about the results.

What do physicists make of all this? They basically fall into two camps. On one side are those who follow David Bohm's lead, and believe that there is a reality to every property of an electron or proton or photon, but that influences travel faster than light, which means that the traditional idea of causality must be abandoned as an absolute, just as the traditional idea of time and space (and mass) as absolutes was abandoned with Einstein's theories of special and general relativity.

Others go much farther. Some will say that a quantum doesn't have a real position or momentum, but only ranges which can be predicted by its quantum waveform. Thus they are forced to say that as a quantum wave approaches a position-sensing device such as a phosphor screen, as it is sometimes put, "a miracle happens." The waveform collapses. This is caused partly by the quantum and partly by the measuring device. Thus a quantum's position is not real until it is measured. But what is so special about measurement that can create reality of one kind and not another?

Niels Bohr would say that there is no deep reality. All we have is measurements. Perhaps that is true. But then why do the measurements correlate? Perhaps nature itself is not real. But something behind it, that sustains correlations, is. There must be some deep reality.

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[12]Greenberger DM, Horne M, Zeilinger A: "Going beyond Bell's Theorem." In *Bell's Theorem, Quantum Theory and Conceptions of the Universe.* Kafatos M, ed. Kluwer Academic Publications, Dordrecht, The Netherlands 1989, p. 69. See also Mermin ND. "What's Wrong With These Elements of Reality?" *Physics Today* 43(6):9-11, 1990.

There are those who say that consciousness creates reality. But then why should different consciousnesses create the same reality so much of the time? Does this imply an ultimate Consciousness that correlates the other consciousnesses? There are previously agnostic scientists who think that it does.

Some would say that the measurement act creates reality, or selects from different kinds of potential reality. But why should it create one kind of reality and not another? In an effort to get away from this problem it has even been proposed that both realities are created, that every time a quantum measurement is made, two universes are created simultaneously. But what makes quantum measurement so special that it can create universes when other processes can't? And how many universes does it take? (Remember that there are millions of positions that each electron may strike on our tube, and millions of electrons that strike the tube every second that you watch. The numbers rapidly get out of hand.) And that still doesn't answer the question, why are we in the universe we are in? For even if there are multiple universes we only experience one of them, and that fact alone demands explanation.

The opposite tack has been taken by some who say that the universe is an undivided whole. This view has trouble explaining the apparent divisions. But perhaps the organizing power behind the universe is an undivided whole.

Some have even suggested abandoning the basic logical principle that a statement cannot be both true and false in the same sense at the same time (Aristotle' law of the excluded middle) as it applies to quantum objects. But this law would seem to be necessary if one is to say anything intelligible. No satisfactory substitute for this law has been proposed. And David Bohm's theory demonstrates that it is not necessary to abandon normal logic when dealing with quantum objects.

Even with the most conservative interpretation of quantum theory, there are correlations between events where neither event can cause the other, and yet the particles do not carry the correlation with them. Since there are correlations, something does the correlating. It is not communication between the particles. It is not an inherent property of the particles themselves. It is therefore not bound by our normal laws of causality. We are brought face to face with the organizing power of the universe in a direct

way. God is acting in the here and now.[13] The universe does not run by itself.

Some will say that this is only according to quantum theory. No, the above is true even if quantum theory is superseded. The above experiments are valid even if our explanation for them has to be changed. It still is true that photons and protons have spin correlations at great distances, and that these correlations are not entirely carried by the particles themselves or communicated by other particles travelling at or below the speed of light. The introduction of particles travelling faster than light will not help, because then the question becomes, Which way does the communicating particle travel? To at least some observers, the communication is instantaneous. Nature cannot do this and maintain causality. Only a God outside of nature can make the experiments come out right.

So the third thing that we can learn from nature is that God is intimately involved in running it on a day-to-day basis.[14]

The Origin of Life

There is a final fallback position of scientism. Perhaps God got the universe started, and perhaps He is intimately involved with its day-to-day operation. But quantum theory predicts that the tiny variations we have noted above cannot be used by us to convey messages faster than light, and so there are still no macroscopic breaks in the cause-effect chain. There are no large-scale miracles. God will still not step in and make a direct change in the large-scale operation of the universe. For practical purposes, the universe still runs on automatic.

Unfortunately, this position has no explanation for the origin of life. Everyone, from literal creationists to believers in scientism,

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[13]Strictly speaking, we can only say that a god is acting in the here and now. But it is simplest to assume the identity of this God with the One Who organizes the universe and Who started it. Ockham's Razor puts the burden of proof on those who would differentiate the two.

[14]According to this analysis of quantum theory God is involved in much more than just these experiments. All quantum phenomena involve influences travelling faster than light, including light, so God is involved in literally all that we see. He is also involved in all molecular bonding. That doesn't leave much out of His domain.

believes that life did not originate at the time the universe was created. Perhaps it was two days later, perhaps eighteen billion years later, but it was later. So from the point of view of the believer in scientism, life must have arisen by natural processes. But there are are no natural processes that can account for its origin.

As an undergraduate student in chemistry, I had learned about the Miller-Urey experiment, and the theory that life had evolved in the sea as amino acids combined to form proteins, and nucleic acids combined to form DNA and RNA, then supramolecular assemblies, and finally cells. I was also aware of the theological implications of the theory. So I decided to research the subject and give my senior chemistry seminar on it. I was expecting to find some room for doubt regarding the theory. But I was totally unprepared for the one-sidedness of the evidence I found.

Chemical evolution requires four steps. 1. The basic organic building blocks have to be made from readily available compounds such as water, atmospheric carbon dioxide, nitrogen, sulfides and/or sulfates, and possibly methane and ammonia. 2. The building blocks must be joined into long chains with some kind of order. 3. The chains must be assembled into supramolecular assemblies. 4. These assemblies must start working together to perform the functions necessary for life.

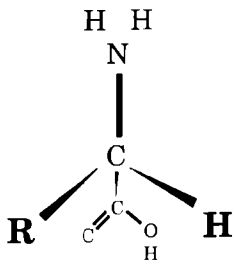
According to theory, all these steps had to be accomplished by random processes, as nature obviously did not manufacture raw materials, transfer them to test tubes, allow them to react, and purify the products according to a predetermined plan before proceding to the next step.

For those who are a bit rusty on their biochemistry, a short review of the biochemical basis of life follows:

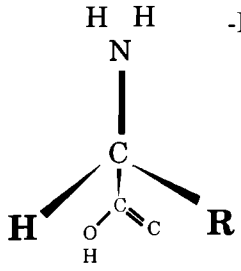
1. Simple building blocks. For proteins (the most studied molecules), the basic building blocks are amino acids, or more properly alpha-amino acids. These have the general structure shown below (with the exception of proline, which is cyclic).

They all are capable of coming in two forms (the L- and D-forms), which relate to each other in much the same way as our left hand relates to our right hand. The amino acids found in the proteins in living organisms are all "left-handed" (the L-form). Amino acids made without special asymmetric catalysts such as enzymes (which have not been found in nature except in associa-

Amino acids

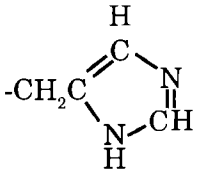


L-form



D-form

-R = -H (glycine)
-CH_3 (alanine)
-CH_2OH (serine)
-CH_2SH (cysteine)
-CH_2COOH (aspartic acid)
-CH_2CONH_2 (asparagine)
-$CH_2CH_2CH_2CH_2NH_2$ (lysine)

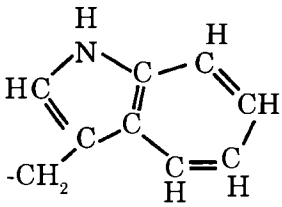


(histidine)

Some amino acids which do not occur in proteins:

-R = -CH_2CH_3
(α-animobutyric acid)

$NH_2CH_2CH_2COOH$
(β-alanine)



(tryptophan)

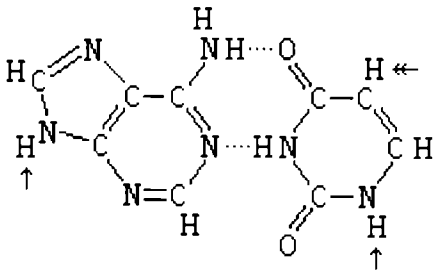
(plus 11 others)

tion with living or previously living organisms) are always a mixture of half left-handed and half right handed forms.

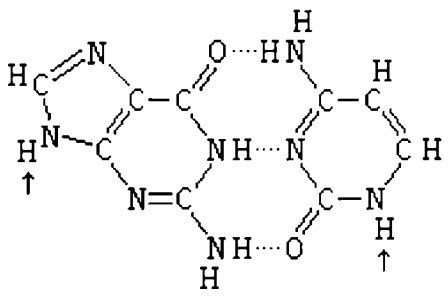
There are many other amino acids, such as alpha-amino butyric acid, beta-alanine, and gamma-amino butyric acid, that would tend to interfere with normal protein synthesis.

Purine and pyrimidine bases account for the special properties of RNA, or ribonucleic acid, and DNA, or deoxyribonucleic acid. Their structure is shown below (Thymine has the same structure as uracil except for a methyl group instead of the hydrogen at the double arrow). The points of attachment to ribose or 2-

Purine and pyrimidine bases



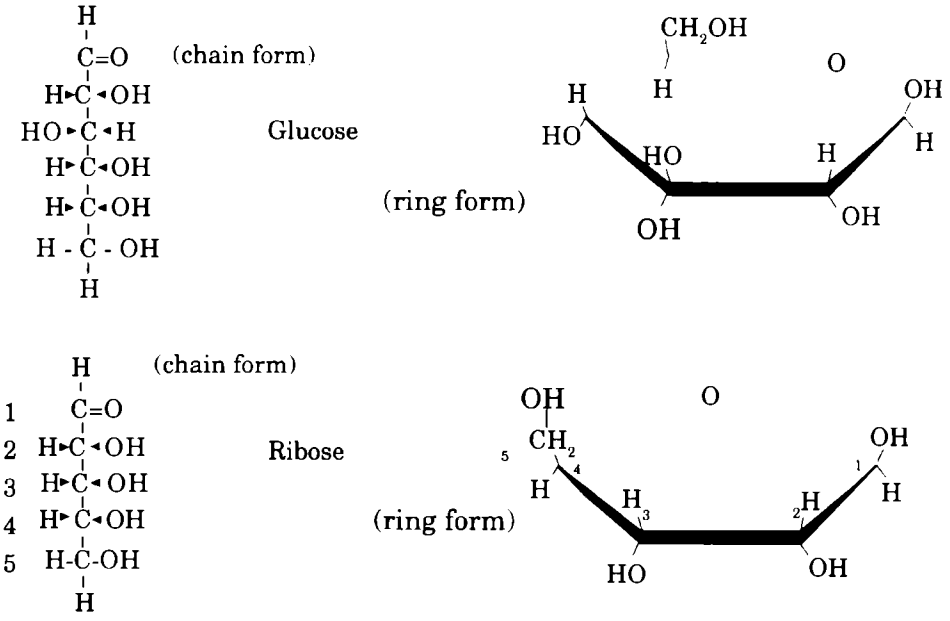
Adenine Uracil



Guanine Cytosine

deoxyribose are indicated by the single arrows. Notice that the bases can fit together in only one way. This is important for the structure of nucleic acids.

Sugars



2-deoxyribose has another H instead of the OH on carbon 2

The simple sugars which, according to current theories of molecular evolution, are necessary for life are glucose, ribose, and 2-deoxyribose, shown above. They also come in left-handed and right-handed forms.

In addition, fatty acids are necessary for life. They are used in forming membranes. They have a long hydrocarbon chain attached to a carboxylic acid group. An example is palmitic acid, $CH_3\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2\,CH_2COOH$.

2. Large molecules. Lipids are relatively simple compounds composed of fatty acids attached to glycerol, choline, and other compounds.

Polysaccharides are compounds made up of many simple sugars and modified sugars joined together. These have not been thought to be terribly important in chemical evolution and have not been studied much from that aspect.

Proteins are made up of amino acids, joined in a specific se-

quence. Proteiniods are not found in living matter, but can be found in certain experiments which we will discuss below. They bear the same relationship to proteins that the letters IE MDI^{G} KSI S_{WH} EICWOS^{DKCI} WSSSCTRG$_{DIDME}$ EL KFI^{XCK} DS DPW $_{WODJEIDJSJ}{}^{DLF}$WE IU bear to the sentence TRANSFER THE TERMINAL PHOSPHORYL GROUP FROM ADENOSINE TRIPHOSPHATE TO THE NUMBER SIX CARBON OF GLUCOSE. Nucleic acids are formed by combining purine and pyrimidine bases with ribose or deoxyribose, and joining the resultant products together with a phosphate between each ribose or deoxyribose. Remember that the bases can fit together in only one way. This means that two strings of bases attached to ribose and phosphate (ribonucleic acid or RNA) or 2-deoxyribose and phosphate (deoxyribonucleic acid or DNA) are reverse matches to each other, and if they are separated and the bases of each strand again reverse matched, two new strands of DNA or RNA will be made identical to the old one and to each other, or RNA can be made from DNA and vice versa. The result is a coding system that can specify the manufacture of particular proteins and replicate itself with help from certain enzymes. This preservation, copying, and decoding of information is essential to life.

3. Supramolecular assemblies. When the requisite molecules are mixed, sometimes a supramolecular assembly will spontaneously form. An example is ribosomes, which have been separated into their RNA and protein components. These are then purified and mixed to produce functional ribosomes. Sometimes the assembly is defective, as when this process is applied to membranes. A membrane will form spontaneously across a hole in a barrier when the parts are mixed, but it will not have an inside and an outside as the membrane in a cell has. Sometimes all our efforts to date are incapable of producing the end product, as in the case of mitochondria. Not much experimentation has been done in this area except on viruses, so no definite conclusions can be drawn at this point.

4. Life. Step four, from macromolecular assemblies to life, has never been demonstrated. The only fact we know is that the reverse process, death, occurs to all organisms. In fact, the greatest advance in biology was the discovery that spontaneous generation did not occur (some may argue that biological evolution was the greatest advance in biology, but even it depends on the foundation that life comes only from other life).

Experimental evidence. Many experiments have been done trying to form the basic building blocks of life. In my seminar I reviewed all the experiments I could find.[15] I have not seen any experiment since that would change my basic assessments.

First, not all of the amino acids used in protein have been made. I have not seen an experiment which produced tryptophan.[16] Then all the experiments produced equal numbers of left-handed and right-handed amino acids. And most, if not all (they were not always looked for) produced amino acids not found in proteins. Fatty acids beyond propionic acid have not been formed. In this enviornment sugars cannot be produced without immediately being destroyed. Sugars attached to phosphate are even more unstable. And I have only read of two bases, adenine and possibly guanine, being produced in measurable amounts.[17]

Worse yet, the **major** product of the experiments was hydrogen cyanide. Attempts to get around this difficulty consist of explanations of how hydrogen cyanide is necessary to form amino

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[15]A later and more complete review including more than 60 such experiments was done by R Evard and D Schrodetzki ("Chemical Evolution". *Origins* 3(1):9-37,1976). Their bibliography is still the best I have seen on the simple experiments. For a popular summary of the evidence from the point of view of scientific orthodoxy, see Orgel LE: "The Origin of Life on the Earth." *Scientific American* 1994;271(4):76-83. Other summaries can be found in biochemistry textbooks such as Zubay G., ed.: *Bilchemistry*. 2nd ed. New York: Macmillan Publishing Company, 1988; or Lehninger AL, Nelson DL, Cox MM: *Principles of Biochemistry*. 2nd ed. New York: Worth Publishers, 1993. A good critique at a popular level from a skeptical point of view is Shapiro R: Origins: *A Skeptic's Guide to the Creation of Life on Earth*. Toronto: Bantam Books, 1987. A good critique from a theist (but not special creationist) point of view can be found in Thaxton CB, Bradley WL, Olsen RL: *The Mystery of Life's Origin: Reassessing Current Theories*. New York: Philosophical Library, 1984.

[16]There is one statement in Thaxton et al., note 15, p. 27, without a reference. One point to remember is that simply having trace amounts of some compound is not enough to assume it had a major role in the next step in chemical evolution. The questions of quantity and stability must also be considered.

[17]I have read of one "random" experiment where the synthesis of guanine was reported (Ponnamperuma C: "Abiological Synthesis of Some Nucleic Acid Constituents." In Fox SW, ed.: *The Origins of Prebiological Systems and their Molecular Matrices*. New York: Academic Press, 1965, pp. 221-36). The adenine and guanine were identified by two-dimensional chromatography, which does not lead to as secure results as gas chromatography/mass spectrometry (see Thaxton *et al.*, note 15, p. 29 note), or perhaps high pressure liquid chromatography or bioassay. The only experiments which have produced pyrimidines were really chemical syntheses, except for an unpublished report (see Thaxton *et al.*, note 15, p. 24).

acids. That may be true, but I fail to see how cytochrome C would have evolved with no oxygen *and* abundant hydrogen cyanide.

This curious fact seems to be systematically ignored in all the popular presentations I have read and even in most of the technical presentations. One can only wonder why.

The only successful experiment to produce sugars that I could find was done in 1955 by Melvin Calvin who produced urea, formaldehyde (that's right, formaldehyde), and formic acid, and took the formaldehyde and added it to water standing on limestone. He got sugars up to 6 carbons, but they decomposed in the presence of limestone unless trapped in more complex material. Of course, there was a lot of leftover formaldehyde, which would wreak havoc on any life that might possibly evolve.[18]

So from experiments imitating natural processes we have gotten (with the help of traps) all the sugars, most amino acids, one or possibly two purine and no pyrimidine bases, and no fatty acids, along with several incorrect compounds and at least two major toxins. We can't even get all the major building blocks needed to produce life. I fail to see how we can be expected to score a run when we can't even get to first base.

Our putting the building blocks together has been no more successful. Fox and colleagues have taken a mixture of amino acids with glutamic and aspartic acids in excess (they had to do this to allow the mixture to melt without decomposing) and produced long chains resembling proteins, except that they were random. These proteinoids did not contain cysteine or tryptophan.

We still are a long way from proteins. Suppose that somehow, out of the soup which the primitive sea was supposed to be, you were able to obtain the 20 protein-forming amino acids in their L-form without any contamination by other amino acids, and heat them. If they all combined equally well, the probability of forming a protein of 250 residues (an average-sized protein) by random combinations is one in 10^{326}. It is much less than the probability of filling the entire universe with sand, with one red grain

[18]*Chemical Evolution*. Oxford: At the Clarendon Press, 1969, Pp. 125-6. Since I did my original research I have found a few other similar experiments which produced ribose. Two experiments actually were reported to produce deoxyribose, although one was essentially a chemical synthesis (Oró J: "Stages and Mechanisms of Prebiological Organic Synthesis." In Fox, see note 17, pp. 137-62. The other was not considered definitive by the person reporting it (Ponnamperuma in note 17, esp. pp. 223-7). The identification was again by two-dimensional chromatography.

in it, and grabbing at random the red grain of sand. You could go on for a billion years checking sand grains and never stand a chance of finding the sand grain you were after.

But supposing you did make a protein. Which would be the most likely protein to make? Obviously one without tryptophan, since tryptophan is neither made nor incorporated into proteinoids by random methods. What kind of proteins do not have tryptophan? Silk fibroin, collagen, maybe elastin (all structural proteins with no catalytic activity), and ribonuclease, which instead of making RNA tears it down.

Consider RNA. There have been several attempts to synthesize RNA by mixing the four bases attached to ribose (remember only one, adenine, has been made by random methods) and polymerizing them by chemical agents or heat. All the experiments I have seen have produced 2'-5' linkages instead of the natural 3'-5' linkages. In other words, even given the raw materials, RNA cannot be produced by random methods. This is not simply a very low probability. This is *zero* probability.

Then consider DNA. DNA can only make 3'-5' linkages, because there is no hydroxyl group on carbon 2 of 2-deoxyribose. But DNA has to have 2-deoxyribose as well as the bases and phosphates needed for RNA, and 2-deoxyribose has not been made by random methods. As we have seen before, only adenine among the four bases has been made by random methods. So, according to all the evidence available, DNA cannot be produced by random methods.

But supposing you could create DNA of exactly the right length from deoxyribonucleotides. And supposing that only 2 out of every 3 residues needed to be in order. The smallest free-living bacterium I know has a DNA molecule that contains 1.1 million bases. The chances of the right DNA forming are one in $10^{441,510}$, that is, 1 divided by 1000000000 . . . (441,493 more zeroes) . . . 00000000 (with this type, it would take about 197 pages to write all the zeroes).

That number is so small it has no meaning to most of us. It is comparable to the chances of dumping a 5-ton truckload of pennies (1,466,666 of them) on the street and having them all turn up heads. Would you believe someone if he said that he tried it and it happened? If someone does, I know where he can get some waterfront property in Florida very cheaply. Another comparison is that it has the same chance of occuring as a measurement 45,091 standard deviations off, which is the same as the chances of finding a man

over 11,278 feet tall (the standard deviation for a man's height is 3 inches).

"But," somebody says, "there are a million different bacteria that could have been formed, and there were a billion years when, all around the world, DNA was being formed." Well, the number of bacteria that can live in an atmosphere containing large quantities of hydrogen cyanide is small. But supposing that there were a billion different kinds of bacteria that could be formed. That would improve the chances to 1 in $10^{441,501}$. If the DNA was formed every second for over 3 billion years, the chances would be 1 in $10^{441,493}$. And if it was being made in every square inch of the earth's surface at that rate, the chances would be raised to 1 in $10^{441,475}$. By these assumptions we have raised the chances by 10^{35}, but we still have so far to go before it becomes remotely possible that it is not worth considering seriously. The estimates in the foregoing calculations were extremely liberal, and from the evidence we have, the conditions we assumed about the abundance of nucleotides did not exist.

So we can't form all the amino acids, any of the membrane-forming fatty acids, more than one purine base, the sugar needed for DNA, usable proteins, or RNA in its normal form, and the chances of producing DNA are worse than astronomically small. It would seem that the chances of producing life are less than those of producing the Oxford English dictionary by an explosion in a print factory. They are more like those of producing said dictionary by an explosion in a Russian print factory.

But it gets worse. Even getting life once we have the macromolecules is impossible. Every can of chicken soup is a testimony to this. Chicken soup has all the DNA, RNA, and protein we could wish, including properly formed enzymes, with plenty of lipids to make membranes and sugars for energy and structural needs. It is even in almost the right order. And yet Campbell's makes lots of money because bacteria don't reconstitute once they are disorganized beyond a certain point. Primordial soup has to have been much thinner than chicken soup and not nearly as nutritious. It would take a miracle to get life out of primordial soup.

And that is precisely what we are talking about. The origin of life was a miracle. We have not settled when the Creator did it. We certainly have not settled how. But that the Creator "stepped into" our universe after it was formed, and performed another act of creation that involves us directly, there is no reasonable doubt.[19]

[19]Again it could theoretically be a different God, but again Ockham's Razor dic-

Therefore, the position that science can explain everything is disproved by the results of science itself. It is a pervasive position in our time, and we will have to constantly be alert for it, but we need not bow in obeisance to it. We will have to keep this in mind as we work on the rest of our theology.

To summarize, from nature we can learn that Whoever God is, He runs His universe in a very orderly way the vast majority of the time. Miracles should be relatively rare, and one might expect them also to exhibit orderliness. We can also learn that He started the universe, that he is intimately involved in its day-to-day operation, and that when He chooses He can step in and act creatively, and that life seems to have a special place in His heart.[20]

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tates that we identify this God with the previous One without evidence to the contrary.

Strictly speaking, the Creator was never "out of" our universe, as we have seen from quantum theory. He simply acted in a way that is not consistent with all known physical laws, specifically defying the second law of thermodynamics. It may very well be that in superseding physical law He was guided by a higher law, perhaps one that takes into account the thought processes of intelligent beings.

[20]It is true that we have not "mathematically" proved the above assertions (although after Lakatos one might be suspicious of that kind of "proof" as well), but there is no credible evidence for any other theory given our present knowledge. The current scientific orthodoxy is, on this issue, struggling against the scientific evidence on the origin of life. Atheism and pure Deism are maintaining a belief in spontaneous generation in defiance of the known facts, similar to the manner of the Flat Earth Society.

Some may try to denigrate the above arguments by saying that they are a sophisticated form of the "God of the gaps" argument, which has supposedly been discredited by science. This objection ignores the fact that these particular gaps were discovered by science, and are growing more firm with time rather than less so. In prescientific times the universe was believed to be static, causality was believed to be universal by many, and spontaneous generation was an accepted "fact". It is science that has destroyed this picture of the universe.

There may also be those who are uncomfortable basing theological positions on scientific arguments instead of the Bible. These may note that the approach recorded in the book of Job (38-41) as used by God to convince Job of the error of his theology is precisely the same kind of approach. "Where were you when I laid the foundation of the earth? . . . Where is the way to the dwelling of light . . . ? . . . Who has let the wild ass go free?" If God can use a "God of the gaps" argument, it would seem that we are justified in doing the same.

In fact, I am not sure that there is any other kind of argument for God, or anything else for that matter. Any entity is inferred by its effect on our senses, or on its effect on something that affects our senses.

3

INSPIRATION AND REVELATION

The supernatural[1] is somewhat more difficult to study than nature. This is partly because it is not reproducible at will. We do not have access to the supernatural except as it chooses to show itself. This means that most of our evidence on the supernatural is historical. We have to pay much more attention to such things as the character of witnesses, their proximity to the events recorded, and their biases, than we are accustomed to doing with scientific evidence.

All supernatural events say something about God In some events, we can deduce something about His character by actions which can be observed by anyone present. In other events, so it is

[1]I am using the term "supernatural" to mean that which does not conform to the laws of nature which are the same for all participants regardless of their thought processes. Any such events should tell us something about that part of reality which is beyond, or behind (or whatever your favorite expression is), that part of reality which we call nature. That there is such a part of reality can be deduced from the existence of life.

claimed, He actually sends messages to people. So we have the visions of Paul, Joseph Smith, and Ellen White, the LORD speaking to Moses, and the "we" of Mohammed. These people then become authoritative for their followers. But now we have a problem. For we cannot follow the authority of all these people at once. In such a simple matter as the number of wives a man may have, there is a divergence of opinion. Moses and Joseph Smith do not give any numerical limit, Mohammed says no more than four (except for Mohammed himself), Ellen White says one, and Paul says one if you wish to be a church leader, but otherwise gives no limit. It is not a matter of denying (at this point) the possibility that God spoke to all of them. It is rather that we cannot base our actions on what one authority says without implicitly disagreeing with another authority.

The problem cannot be solved by insisting that each group adhere to its own tradition. For Paul, Ellen White, and Joseph Smith urged their followers to win other people over to their way of thinking and acting, and Mohammed's followers invented the slogan "the Qur'an, tribute, or the sword" to summarize their relations with other religions.

We have come to an area of controversy in Christendom. Is the Bible authoritative? If so, in what way and for whom? Is it inspired? How is its authority related to other authorities, religious and otherwise?[2]

One way of attacking the problem is to construct a theoretical model of inspiration and see whether a given writer who claims inspiration fits our theory, and see what the implications of our theory are for the question of authority. I find it more useful to try to understand what we mean by authority, and then discuss the implications for inspiration in general and that of particular cases such as the Bible.

Authority

There are two closely related meanings of authority. One meaning is a dependable source of accurate information. I will

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[2]For some groups, such as Seventh-day Adventists, there are other questions that needs to be answered, such as, is Ellen White authoritative (or more accurately, should she be)? If so, in what way and for whom? Was she inspired? How should we relate her authority to that of the Bible?

use the unqualified term authority in this sense. The other meaning is a source which is believed to be a dependable source of accurate information. I will use the term reputed authority in this sense. The former sense is of more interest.[3] A useful authority is one which predicts phenomena or recommends courses of action, in situations which are occurring or are likely to occur.

One function of authority is as a handy reference. Even if there is no controversy over the proper answers, it may be convenient to have an authority with all the answers listed. Logarithm tables, for example, can be very useful. But a more useful function of authority is arbitration of disputes. If several groups are arguing over some factual information or the proper course of action, one group will often appeal to a reputed authority, and if the other group concedes the authority of the source, the argument is settled in favor of the first group. In fact, if an authority cannot function as an arbiter of disputes, it has very little use. Even the "handy reference" kind of authority is capable of functioning in this way. For example, in our culture the value of π = 3.14159265 . . . is not in dispute. Formerly, this was not so. The ancient Greeks used $\pi = 3\ ^1/_7 = 3.14285714\ldots$, while the Egyptians used the formula for the area of a circle $A = (^8/_9\ d)^2 = 3\ ^{13}/_{81}\ r^2$, which presumes $\pi = 3.16049\ldots$ In our own day the approximations $\pi = 3.14$ and $\pi = 3.1416$ are commonly used. If someone needs a value of π accurate to 6 or more places, it is better to trust the first value mentioned than any of the others. On this point the Egyptian papyri are inferior to, for example, the *Chemical Rubber Company Handbook of Chemistry and Physics.*

To make the point another way, an authority is useless unless it can stand in the face of uncertainty and contradiction. That is, if there does not exist some situation where you would ordinarily be inclined to believe or act one way, and a given source changes your belief or course of action, then that source actually has no authority for you.

We have come to a frightening aspect of authority. There are sources that claim authority which actually have none, either because they are ignorantly in error (such as people in Columbus' day who believed the earth was flat), or because they have

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[3]There is also the meaning someone or something which one obeys, or should obey. I am assuming that if one believes an authority, one will obey him/her/it.

no respect for truth (such as some used car salesmen). An authority is useful precisely where a falsely reputed authority can do the most damage. If taking all the other facts you know into account, you would prefer to do A, and a reputed authority says to do B, it is important to know whether that reputed authority is in fact an authority. Yet it is at this point that it is hardest to evaluate a reputed authority. If the other facts point to the same course of action as the reputed authority, you can evaluate the reputed authority by the other facts, and it is a lot easier to believe the reputed authority, but in that case you don't really need it. The reputed authority comforts but doesn't help.

Suppose that you have a large freckle on your right (or for left-handers left) hand. You go to the doctor, perhaps for something else. The doctor says, "Let me look at that freckle." He (or she)[4] asks a few questions, looks at it, takes a piece to look at under the micro-

[4]In general, I have attempted to use gender-neutral language in this book, because the points made usually have no direct connection with gender. I have made three major exceptions; the following passage, the reference to prophets, and God.

English is not ideally suited to gender-inclusiveness. The pronouns are most difficult. "It" connotes a thing, not a person. "He or she" or "he/she" is tolerable for minimal use but rapidly becomes awkward, and to the really picky is not even adequate—it should be "she or he" half the time (and which time should come first?). "He" or "she" forces one to choose gender, in some cases arbitrarily. The gender-inclusive use of "he" was the standard in a previous age, but many do not consider it adequate today. The use of the word "one" is a compromise that is sometimes workable. The mathematically inclined realize that content is more important, and do not worry as much about the form. One simply chooses the form that appears the most helpful and uses it.

However, with these three usages, the personal pronoun is impossible to avoid without the passage(s) becoming extremely awkward. In the present passage I have chosen the masculine pronoun because most physicians in the Western world are male, and because I am mentioning that some of them should not be trusted (I suspect that in general, female physicians are slightly more trustworthy). However, what I say is applicable to both genders, so the pronoun should be interpreted as gender-inclusive. Similarly, the vast majority of reputed religious (and scientific) authorities, or at least of tho ones who have been recorded, have been male. There are female reputed authorities, and the same principles apply to them.

God has usually been referred to as "He" in the Judeo-Christian tradition. This is probably partly leftover sexual bias, partly because the masculine pronoun seemed more appropriate for someone with an active role (in itself partly sexual bias and partly generalization from the fact that men are, on the average, bigger and stronger than women), and partly to avoid sexual overtones when discussing the love between God and men. The latter reason is reversed for women, although I suspect not precisely as, in general, women tend to view the relationship aspect of sexuality as more important compared to the physical than men do. I believe that God is beyond the usual delineations of gender, but find "He/She" or "She/He" very awkward to use, and so have chosen to use the more traditional "He". I hope that both those who have trouble with the terminology used and those who agree with it will look beyond the terminology to the concepts discussed.

scope, and then tells you, "I'm sorry to have to tell you, but you have cancer, and because of where it is, your hand will have to come off at the wrist or we will have no chance of curing it." What do you do? It doesn't hurt, and you are really not excited about losing your hand. On the other hand, you have years still ahead of you and are not interested in dying just yet. Is your doctor telling the truth? Or is he just a quack, out to get your money, or perhaps unable to tell when just cutting off the skin and grafting over it, or immunotherapy, or acupuncture, will do just as well?

If you are a doctor yourself, you might ask to look at the slides, and then go home and get out your own medical books. But if you are not medically trained, and unable to travel easily to get another doctor for a second opinion, you have to figure out whether to trust your doctor or not. And three questions may help you to decide.

First, is the recommended course of action credible? Well, yes, you have heard of cancer and know that the usual treatment is cutting it out if possible. You have never heard of cancer looking like that, but suppose it to be possible. If the doctor had asked you to cut off your other hand, it would have required much more justification.

Second, does the source (in this case the doctor) have a reputation for honesty? Regardless of the other qualifications, if this one is lacking, you cannot trust anything he says unless you can confirm it from another source.

Third, is the source informed? Does the doctor know enough about dermatology to recognize skin cancer? Does he know enough about pathology to read his own slides? Or did he send them to a reputable pathologist? Does he know the best treatment for skin cancer? If the doctor has an excellent reputation, you might be inclined to trust him without even checking it out. On the other hand, if he has ten malpractice cases against him in the past year and was just kicked off the staff of the local hospital for incompetence, you would certainly insist on a second opinion and might even ignore his warning. You may not even have gone to him in th first place.

In obvious cases there will be a consensus of opinion whether to believe or not to believe. But there will be some cases which will be very difficult to decide. And you can never be absolutely certain about the result. Even a good doctor sometimes makes mistakes, and even a charlatan may be giving you an accurate

diagnosis. Reputable medical journals have been known to inadvertently publish fraudulent research. The course of investigation outlined above does not guarantee that no mistakes will be made. It merely offers the best chance of making the right decision.

I am postulating that the same three questions are pertinent when considering the advice of a reputed religious authority. Dishonesty disqualifies. Unreasonableness makes the reputed authority more difficult to believe. And it is vitally important to determine the source of information, and the reliability of that source. This is true whether there is a claim to better insight through piety, the claim of direct control by the Holy Spirit, or reporting the words or works of God.

Honesty

The point about dishonesty deserves explanation and emphasis. Some may reject this as an *ad hominem* argument ("The guy's a communist [or capitalist or Nazi or black or Christian or atheist or whatever], so everything he says is wrong"). Most scientists are reticent to condemn someone's work because she doesn't pay her income tax. Some theologians, too, insist that God can speak through dishonest people. Such arguments miss the point. The point is not that God cannot communicate in a special way to someone who has been dishonest, or even someone who is chronically dishonest. The point is that we can't trust him or her.

In ordinary life when someone is chronically dishonest we are unwilling to believe anything he says enough to act on it, unless either his word is confirmed by something reliable, or he appears to have no motive for dishonesty in this case (hidden or overt) and motive to be accurate, or it doesn't cost us anything to believe him. Reputed religious authorities nearly always have a motive for lying that God has revealed something to them, if only to become somebody important. Usually the claim is a powerful way to silence the challenges of one's detractors in one's own mind ("Who are they to argue against God? I am but His humble servant"). It also enables one to have a greater measure of control over one's followers. Lying about one's religious experience is also relatively safe, at least in the short term. It is difficult for anyone to prove that God did *not* speak to you if you say that He did. Therefore in order for us to believe a reputed authority who is known to be dishonest, he must either be advising something

with no apparent risk, or something we would believe without his advice. In either case he is not much use.

There are rare exceptions, of course. Assuming the facts of the case in the Bible are accurate, I would be strongly inclined to believe the prophecy of Baalam even though there are grounds for doubting his integrity. He had strong reasons to say the opposite of what he did, or at least to say nothing. This makes his testimony believable. But in general, you cannot trust someone who claims religious authority if he is dishonest.

What about other types of sin? We all are sinners, so if any type of sin disqualified one from being a prophet, there would be no prophets. However, some bad actions have little to do with the ability to accurately report what one sees, at least initially, and they detract from the message primarily as they demonstrate that the prophet's message has not yet transformed all of his own life. An example might be overeating. Other types of sin more directly involve one's integrity, and have more direct implications for trustworthiness. Examples might be greed and pride.

Why do scientists dislike *ad hominem* arguments when scientific theology makes this much use of them? First, scientists do not usually deal with theories which purport to offer ways to change human nature, whereas religious theories usually do so. How Einstein treated his friends has virtually nothing to do with whether objects are more massive in motion than at rest, whereas how Jesus treated his friends has a lot to do with whether the God revealed in Jesus loves us unconditionally. Second, scientists deal with repeatable phenomena (if you don't believe it you can try it for yourself), making dishonesty risky and therefore less attractive and less likely. Most religious authority is based on unrepeatable events (we can't manufacture another Jesus), making dishonesty less easily discovered and therefore more tempting. In scientific experiments which are essentially unrepeatable for technical reasons, the integrity of the investigators becomes more important. Third, in one area there is no gap between the two attitudes. If you have been proven to have falsified scientific research, all of your research is considered of no value. Anything coauthored by Dr. John Darsee might as well not have been written. More properly, it would have been better if it had not been written, as it just serves to confuse the unwary. Finally, there are actually two kinds of *ad hominem* arguments. There is a world of difference between calling a man an atheist or

a capitalist or whatever and calling him a liar. In the former case his viewpoint may be biased (although then again it may not), but his data still demand explanation. In the latter case his data are also suspect.

The above considerations make me unable to accept the authority of Joseph Smith. He was reliably reported to have claimed supernatural help in finding treasure before his religious career, a claim that I believe to be fraudulent. His religious career gives evidence that this pattern of fraud was not abandoned. One can read many of his revelations as self-serving (for example, those on polygamy). His religious revelations were supposed to come from documents most of which, although tangible, have not left any tangible evidence. The one document which has left tangible evidence is the papyrus from which the *Book of Abraham*[5] was supposedly translated. The hieroglyphics of this papyrus, which we can now read, bear no resemblance to the text of the *Book of Abraham*. We know he was wrong in this case, we have strong reason to suspect his integrity, and even if the Lord did reveal some things to him, we cannot rely on his word to distinguish between what he received and what he made up. That is, he has no authority.

This is also one of the reasons why Islamic fundamentalists are so upset with Salman Rushdie for writing *The Satanic Verses*[6] (not the most important—we will come to that shortly). They perceive that Salman the Persian's comments about the convenience of Mohammed's (for that is obviously who Mahound is) revelations are an attack on his integrity. Salman Rushdie has confirmed that Salman the Persian's questions were his own also.

This consideration also means that Walter Rea's charges in *The White Lie* (or Ronald Numbers' *The Prophetess of Health*)[7] cannot be refuted by merely establishing that Ellen White did not violate plagiarism laws. The weight of evidence must favor the theory that she did not attempt to pass off as direct divine revelation ideas which she knew she obtained only from someone else. If she claimed that certain ideas were inspired by God, and it can be shown that she actually got them from someone else, it

[5]Marquandt HM: *The Book of Abraham Found: An answer to Dr. Hugh Nibley's Book "The Message of the Joseph Smith Papyri, an Egyptian Endowment": As it relates to the source of the Book of Abraham.* Sandy, UT: Marquandt, 1975.

[6]New York: Viking Penguin, Inc., 1989

[7]Rea, W., *The White Lie,* Turlock, CA: M & R Publications, 1982 and Numbers, R., *The Prophetess of Health: A Study of Ellen G. White,* New York: Harper & Row, 1976.

makes it very difficult to defend her authority, but if enough time had passed one could still say that she forgot. But if she can be shown to have known that these ideas came from someone else (whether or not they are wrong), and still denied that they came from someone else but rather claimed that they were directly from God, then her claim to authority must be dropped.[8]

This also means that when someone claims that Moses or Daniel or Paul did not write the books attributed to them, all of the claims for revelation that are made in those books are being judged as worthless. Pious fraud is still fraud. It *is* important whether such statements in the Bible are accurate.

The problem is not one of error. The problem is one of integrity. There is so much room for lying in reporting religious experience that anything provably short of total honesty makes it probable that systematic deception is taking place.

In scientific terms, that the Bible, or Mohammed, or the Papacy, or Mary Baker Eddy, or Joseph Smith, or any other reputed religious authority has authority is a falsifiable hypothesis, at least in principle. This makes some religious people, including some theologians, uncomfortable. How can you have 100% faith in something that might be wrong? I think this uncomfortable feeling is partly due to a misunderstanding of the nature of faith. Faith is not the absence of doubt. Precisely what faith is will be discussed in Chapter 9. For now we only note that Jesus apparently did not hold that faith had to be 100% to be valid. His response to the man who said, "I believe: help my unbelief!" (Mark 9:24) was not to rebuke him (as he had earlier), but to heal his son.

Reasonableness

Our next criterion is reasonableness. Of the above criteria, reasonableness may seem the most important, but it is the hardest to use. Part of the problem is that our idea of what is reasonable is often so misguided. I remember reading in the Seventh-

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[8]At this stage in my personal research I have not found anything I can say is deliberately dishonest in Ellen White's writings. That statement is open to change, and should the preponderance of evidence convince me that it is incorrect, then she could not function as an authority for me. But for now I think she is not disqualified as an authority on the basis of integrity.

day Adventist journal *Spectrum* an article[9] devoted to the idea that we needed to rework Ellen White's scenario of the end of time because it was tied to the 1800's and did not envision the modern world and specifically the rise of communism. Communism appeared to be a permanent part of the world scene and we needed to include it in a new, revised end-time scenario. Today, anyone who argued in that way would be laughed out of court, but it seemed so reasonable at the time.[10] So, although reasonableness is an important criterion, we need to use it humbly, only in extreme circumstances, and even then with the recognition that we may still be misusing it.

In fact, carried to the extreme limit, the criterion of reasonableness would completely destroy any authority. For if you only agree with a reputed authority when it is perfectly reasonable (that is, when it agrees with what you already believe), then it has no authority. One might even say that one has faith in an authority only to the extent that the criterion of reasonableness can be ignored.

However, one aspect of reasonableness is important, and that is consistency. An authority cannot recommend two mutually exclusive courses of action, or we cannot choose one over the other on the basis of that authority, and the suspicion will remain that other recommendations of that authority may in fact have the same ambiguity.

A Reliable Source

Our final criterion is that all religious knowledge must be traceable to either observational knowledge or theoretical knowledge, or it is unreliable. This last statement may raise some hackles, but I think it is nonetheless true.

The first objection to this statement is that just because a religious authority does not claim a specific revelation to back up the truth of a statement does not mean that what he says is false, and he is even more likely to be right in his assertion than someone who is not a religious authority. But the reason he is more

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[9]Butler J. "The World of E. G. White and the End of the World." *Spectrum* 10[2]:2-13,1979.

[10]This does not prove the validity of Ellen White's authority. It is included here to illustrate one of the difficulties in evaluating that authority, and authority in general.

likely to be right is that he has more information, some of which he may not have directly told us, and/or that he has done more clear thinking on the subject. Precisely insofar as you cannot either demonstrate or trust that he has observational or theoretical authority to back him up, you cannot depend on his pronouncements.

The second objection to the statement comes from those who want to take a book, for example the Bible or the Qur'an, as authoritative in every detail without having to justify each part. They say, "But what about God, in His special providence, protecting a book from error in its formation [note that the mechanism is unimportant] and miraculously preserving it for our guidance? Cannot God do that?" The answer is yes, God can do that, but that is not the right question. The question is, did God do that? This question cannot be answered in the affirmative without recourse to either observational or theoretical knowledge. If observations establish highly probable errors in a book, then the theoretical grounds for its inerrancy must be overwhelming before we can assume its inerrancy, and the nagging doubt that we have made a mistake in our theory cannot be dismissed until the observational discrepancies have been resolved.

One final similarity between scientific and religious authority should be noted. A scientist cannot claim to have any intrinsic authority in himself, except in the matter of observing his own psyche. He cannot simply pronounce and it is so. Everything is based either on experiment, which he tries to report without bias, or on theory, which is common intellectual property and (if it is good) appeals to everyone's sense of appropriateness.

Religious authority is similarly transparent. Either it is based on theology, which appeals to all who will see, or it is based on observation of God's activity, which is most authoritative when the relater introduces the least bias. The human instrument is most effective when it is least visible. This is in distinction to, for example, a political authority, which has intrinsic authority (what it says goes whether it makes sense or not).

Theoretical Authority will be discussed further under scientific authority. One point needs to be made here. The validity of such authority is, and should be, judged by how well it fits the pieces of the puzzle of life together. The only caution that should be given is that the person judging the validity of a theoretical

authority is making a partly subjective judgment and this judgment is subject to correction as more information is gained and clearer thinking is done, so we should not be too ready to close our minds on that subject.

Observational Authority, on the other hand, is much more difficult to deal with. Perhaps the easiest way to tackle the subject is to distinguish between four different kinds of authority asserted by people who claim to be religious observational authorities. There is repeated authority, scientific authority, historical authority, and revelational authority. In theory these are almost mutually exclusive, although in practice they are not always distinguishable.

Repeated authority is simply somebody else's authority that the authority in question repeats. Examples are many OT quotes in the NT, the report brought to Paul by Chloe's family about the Corinthian church (1 Cor 1:11), and the entire book of Luke and much of Acts. Luke was not there personally, and he got all his information from what other people had said and written (Luke 1:1-4).

The reliability of such authority is best judged by the reliability of the original authority and the accuracy of its transmission. This is the same standard that one would use in judging a non-religious authority. The reliability of a religious authority in other areas has no necessary relationship to its reliability here, although careless handling of information here might suggest careless handling elsewhere.

Scientific authority can be divided into observational authority and theoretical authority. An example of observational authority is Gallileo taking a telescope and pointing it at Jupiter and saying he sees four moons. Assuming the authority is honest, you have to try to account for his observations. An example of theoretical authority is Maxwell predicting the existence of radio waves, or Einstein predicting that stars near the Sun would appear to be slightly out of position.

In point of fact, the two kinds of authority are not completely separable. Gallileo (with good reason, but this is still an interpretation) implicitly said that his telescope was a reliable instrument, that the light spots which he saw near Jupiter were not optical illusions, and that they actually circled the planet rather than just moving back and forth in its general vicinity. In fact, there are probably no truly raw pieces of data in science. On the

other hand, Einstein's prediction was based on many observations, some of them apparently defying common sense.

One could postulate a third kind of scientific authority, that of the learned scientist or textbook writer. However, as we in medicine are constantly re-learning, this kind of authority is either well-supported in the final analysis by experience (or by well-founded theory), or it is often misleading. One has only to think back to the recent controversy over calcium chloride in cardiac resuscitation to find an example. Even experience can be misleading if it is not carefully and critically observed, as illustrated by the history of the use of diethylstilbestrol (DES) for preventing miscarriage.

The same thing holds true for religious authority in general. It too comes in two kinds, observational and theoretical, exemplified by the prophet and the theologian. Again the two kinds are not completely separable, illustrated well by the prophet who makes predictions concerning the future based on his understanding of the meaning (theory) of what he has been shown (observation). Again there is probably no raw data without any interpretation, and it is doubtful that one can become a good theologian without some observational knowledge of God with which to work.

Scientific religious authority is that authority in a religious source derived from making repeated observations and noting a pattern into which they fit. An example is the observation of the man born blind in John 9:32, "Never since the world began has it been heard that anyone opened the eyes of a man born blind." This observation is still accurate today, except for John 9.[11]

Another example illustrates the (partial) separability of scientific religious authority. It is the observation in Ps. 37:25, "I have been young, and now I am old, yet I have not seen the righteous forsaken, or his children begging bread." That statement can be questioned on several grounds. How does the author know who is righteous and who is not? Has he followed their history adequately, or has he lost track of the righteous whose children may have been begging bread? How far down does the term translated "children" (*zera*^{c}—"seed") extend? Does it matter if the descendants themselves are not righteous? (For that matter, did

[11]To be accurate, this is partly repeated authority, but most scientific authority eventually becomes repeated authority. In fact, the Bible is all repeated authority in one sense. We have only copies of copies of copies, not the originals.

he really mean what he said precisely? Remember, this is poetry.) I accept the statement as a valid generalization (Most righteous people are not forsaken and their children do not beg). That is, it has scientific authority for me. But if I found a righteous man whose children were begging, or even many righteous men whose children begged, it would not cause me to throw out the Psalms as not authoritative, let alone the whole Bible. The basis for this statement is said to be experience, there is no claim for direct revelation, and statements like this may be wrong without disproving such a claim in other areas.

Historical Authority is that authority derived from observing events which are essentially unrepeatable. These may be ordinary events without any obvious divine intervention, events which appear providential, or events which are clearly miraculous. It may not always be easy, or even possible in practice, to distinguish between the three, but the distinction is important, so some illustrations may be useful.

An example of ordinary historical authority is Luke's description of some journeys of the apostle Paul described in, for example, Acts 16:11,12. Paul apparently walked the ordinary way onto an ordinary boat which used the usual sail and rowing power to get from one place to another (there may be something miraculous about Paul's purpose, but not about his actions). However, one could not determine at which cities Paul stopped by conducting experiments. We are completely dependent on witnesses, in this case the only surviving witness, Luke. This is different from scientific authority.

Ordinary historical authority, like scientific authority and repeated authority, has what I have called separability. A person can misinterpret or not remember properly what he sees in this area without thereby destroying his credibility in other areas. As with scientific or repeated authority, this separability is not complete. Careless handling of the data here would suggest the possibility of careless handling of more serious matters.

An example of providential historical authority is the book of Esther. None of the events recorded are impossible from a mechanistic point of view, but their coincidence is so unusual that the author saw clearly a divine Hand in all of this. The events say something about God's care for His people (Because of this, some with a mechanistic point of view have felt themselves forced to deny the veracity of the story).

Here we start to get into two related questions, dependability and canon (the discussion of canon will be delayed slightly). If a religious authority can be shown to be wrong on the crucial aspects of his reporting of providential history, all conclusions supported by the history are no longer valid.[12] This is true even if the mistakes were made by a careful, honest person. If for example, Esther and Mordecai were shown to be fictitious, or the death decree to be non-existent, the religious authority of the book of Esther would be destroyed. This is in distinction to the previous kinds of authority where honest, careful mistakes have no bearing on the dependability of a religious authority.

It might be protested that we can no more draw logical conclusions from false scientific or ordinary historical data than we can from providential historical data. This is true. But it appears to me that a major reason the Book of Esther got into the canon was because conclusions about God and His care for His people can be deduced from the book. While it may be irrelevant to the main point whether there were 127 provinces in Xerxes' day (Esther 1:1, 8:9—ordinary historical authority), it is not irrelevant whether Esther was queen, because removing her from the story destroys the thrust of the book (It is, of course, harder to believe the important facts if some of the unimportant ones are incorrect).

An example of miraculous historical authority is the account of Jesus visiting the 10 disciples (Judas was dead and Thomas was not there) in the upper room on Resurrection Sunday. From a mechanistic point of view the passage of Jesus through locked doors, let alone His being alive, was impossible. This event was obviously felt to tell us something about God. But it still could be (and allegedly was) observed by everyone there. Another example is the Exodus, as recorded in the Pentateuch. Again it was clearly miraculous. But it could be observed by anyone, and it left traces in history (for example, the Israelites were once in Egypt and were later settled in Canaan).

Dependability is an issue here also. For if a miraculous event can be shown not to have happened, then all the conclusions drawn

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[12]I am using the term "valid" in a technical sense. I mean that the conclusions do not flow from the premises. The conclusions may be true, and we may know this on other grounds, but one cannot logically use the history to support the conclusions, and we should stop trying to do so.

from that event are not valid. The apostle Paul saw this clearly. In 1 Cor15:17-19 he wrote, "If Christ has not been raised, your faith is futile and you are still in your sins. Then those also who have fallen asleep in Christ have perished. If for this life only we have hoped in Christ, we are of all men most to be pitied."

This idea strikes at the heart of the usual theological use of the term "Myth". A myth, as I understand the usual use of the term, is a story which did not in fact happen, but which summarizes a theological truth so well that it is worth remembering and repeating on that basis alone. That is, a myth is a story which is untrue at a "superficial" level but profoundly true at a "deeper" level.[13] It is usually applied to stories that obviously have deep theological significance but which modern science has supposedly proven not to have happened, such as the Genesis story of creation or the resurrection of Christ.

There are myths in the Bible in this sense. They are called parables. No one seriously contends that there were two actual sisters who carried on the activities described in Ezekiel 23. I don't think that Jesus was thinking of a particular householder in Matthew 20. In fact, I doubt that there was a householder who would pay a full day's wage to someone who had worked 1 hour.

But parables have no intrinsic authority. Their authority derives from two different external sources. First is the recognition of the truth in the parable. This is no different from any other theoretical authority; it is entirely dependent on the closeness of fit of the message of the parable to real life. Second is the authority of the teller of the parable. When Jesus used the parable of the laborers in the vineyard in Matthew 20, our belief that this truly represents God's attitude is heavily influenced by our belief or disbelief that Jesus had accurate information about God from a source which is not commonly accessible. If He did, then the parable can inform us. If He didn't, then the parable either conforms to our previous opinions (in which case we don't need it), makes sense (theoretical authority), or is (and can be safely) ignored.

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[13]This is, I think, the kindest definition. Some would object that they use the term "myth" as a literary term to describe stories about actions of the gods, and "epics" or "legends" to describe stories about actions of humans, and that these are purely objective terms. But it is fair to say that most of them believe that the "myths" they discuss are automatically untrue because of their subject matter, and therefore their use of the term is even more pejorative, as they do not try to say there is any intrinsic value to the stories.

What this means is that **proving some event is a myth guts its intrinsic authority**. In religion we are sometimes too close to the situation to see it. But it is clear in history. One can deduce part of the character of Abraham Lincoln from the true story of his walking 3 miles to return 6 1/4¢ he overcharged a customer. But anyone who tried that with the story of George Washington and the cherry tree would be laughed out of town. It says something about later countrymen's respect for George Washington. But it says nothing at all about his character. Another example is the Santa Claus myth. It is a great story, but no one does theology based on it.

It is also clear in science. The observations of nature in novels are not a basis for writing physics or biology texts. Nor are psychological studies of characters in novels authoritative for understanding real people (except, of course, those who write and read them). This is true in spite of the fact that many accurate psychological or natural observations may find their way into novels. We just can't be sure they are accurate. For another example, no competent astronomer believes that there are canals on Mars. The fact that several people with relatively primitive telescopes thought they saw them doesn't matter. The fact that it is a romantic notion doesn't matter. With better telescopes, we are able to see Mars more clearly and there are no canals of the described size. The idea is not true. Therefore all conclusions based on the supposed canals, such as the presence of intelligent life on Mars, are invalid. It bears repeating: one cannot draw valid conclusions from an event that did not happen.

Revelational authority is authority derived from events which one person saw or heard, which have left no discernable traces in the surrounding physical universe. Because of this, the only way we can know what happened is to listen to the one who had the revelation.

This means that dependability becomes very important. Since we have no way of checking on what the person saw, or even if he saw anything, and no direct way of knowing who showed it to him, we have to use indirect means of evaluating the truthfulness of his revelation. Does it make sense? Is he the sort of person God might use? Is he honest? Does it fit with the rest of the universe, including previous revelations?

Perhaps this is the place to discuss the concept of canon. Sci-

entific documents do not need special defense. Ordinary historical documents need little defense.[14] But providential history, miraculous history, and revelations all say something about God, and cannot be repeated at will. In addition, they are usually under attack from those who, for one reason or another, do not wish to submit to their authority. Because of this, a culture tends to put a stamp of approval on the works which it feels deserve special protection and respect. This has led in the Christian community to the concept of canon, that is, those books which are authoritative for religion. There are analogous concepts in other religions. The basis for choosing a canon is not usually quite as explicit as outlined above, but most of the time a more subconscious process uses much the same concepts. Notice that although the community chooses the canon, it does so attempting to recognize an external reality. It is not free in theory to choose any books it wants, and its choices can be criticized.

This explains why it is often important to establish authorship for a document. If Barnabas did not write the Epistle of Barnabas, then it may very well have been written by someone who did not have any special authority, and it does not have the same evidentiary value as if it was. The same is true of 2 Peter. In addition, if Peter did not write 2 Peter, the writer lied (see 2 Pet 1:1). This also makes the authorship of the books of Moses the crucial issue that conservatives have sensed all along.

This also explains why the book of Esther was included in the canon. In the book, God is not mentioned, and neither is prayer, and it might seem strange at first glance that the book was included. But the writer obviously believed that the events were guided by Providence, as did Mordecai (Est 4:14). Thus the story falls within the realm of reputed historical authority, and is worth preserving. This also explains why authorship is not quite as crucial here. Anyone with a knowledge of the facts could have written an authoritative book.

I have described the above categories as if they were watertight. In point of fact they are not. Was the conversion vision of the apostle Paul a revelation or a miraculous event? The surrounding people saw and heard something, but with not nearly

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[14]Although they need more than scientific documents—history can not be repeated at will. Therefore it is desirable to preserve original historical documents.

the detail that Paul saw and heard it. When does an event become clearly providential or clearly miraculous? A recent study[15] showed that patients who are prayed for get better more often than those who are not. Does this transform prayer from a miraculous event into science? Perhaps most importantly, if we read a theological statement in the writings of someone who has had information from God (either as providential events, miraculous events, or revelation), how do we know whether the statement is based on special knowledge, on general knowledge, or on someone else's information? This differentiation is particularly important if the statement is under attack (If it is clearly true, it doesn't matter too much where it came from).

It may be useful to have a final category of authority called general authority. This is authority with an obscure basis. Theoretically any statement an authority makes can be traced to one of the above sources—that is, another authority, experience, or perhaps prejudice or idiosyncrasy. But with general authority, we are not told and cannot prove where the source was. This leaves us with uncertainty as to how far to trust it. Many scientific textbooks make statements without backing them up with either scientific literature or personal experience. Likewise, many religious authorities make statements without saying whether the statements are directly supported by revelations or not.

This leaves us with a very difficult situation. How do we judge the validity of general authority? I think it is evident that general authority does not have the same absolute claim that authority coming from revelation, history, or even scientific observation has. If someone says, "I saw this," we either have to believe that he saw something sufficiently similar to what he thought he saw to account for his observation, or call him a liar. On the other hand, if someone says, "This is so," we can believe he is mistaken without invoking dishonesty. However, general authority does have some validity or the statement wouldn't be made. And the more experience the authority has, the greater our reluctance to discard its general authority.

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[15]Byrd RC: Positive Therapeutic Effects of Intercessory Prayer in a Coronary Care Unit Population. *South Med J* 81[7]:826-9, 1988.

I would submit four principles which can apply in doubtful situations. The first is conservatism. I believe everyone, including people who claim revelations, should be considered to be accurate until one can show credible evidence to the contrary. I think that this is particularly true of canonized works. Therefore, for example, I think that the burden of evidence is on those who would disregard the Bible rather than on those who want to believe it. The same goes for the Qur'an, Joseph Smith, Ellen White, or any reputed authority (although, as the lawyers would say, this presumption is rebuttable). This also goes for statements within the Bible. There always exists the possibility that a given statement is supported by, for example, revelation. Therefore no statement should be considered false without good reason.

The second principle is that if (1) one can show cultural influences on a statement, and (2) there is no direct claim to revelation or miraculous or providential event, and (3) the statement can be shown to be incorrect, then the statement can be safely ignored, and ignored without discarding the reliability of the rest of the authority where the statement is found. Thus, the fact that there are four slightly different accounts of the denials of Peter doesn't bother me. Neither Matthew, Mark, nor Luke was there, and they probably (and certainly in the case of Luke) got their information second- or third-hand. Nowhere do they (or John) claim that God revealed to them the exact story. It is entirely reasonable to believe that Peter made three denials of Jesus and that the exact details were seen differently by different individuals and/or got fuzzier with retelling.

The third principle is that the major point (or points) of a revelation (which should usually involve action in addition to belief) must be true for the source to remain reliable. This also applies to historical accounts. Some supporting points may be inaccurate, but they should have some basis in fact. For example, Jeremiah prophesied that another prophet would die within the year (Jer 28:15,16). If that had not happened, Jeremiah could no longer be relied upon when he said, "Thus says the LORD." There is no room for compromise. Thus the authority of a series of revelations is testable in the scientific sense. It is falsifiable, at least in theory.

On the other hand, the fact that Lev 11:6 says that the hare chews its cud doesn't bother me. Imagine yourself as God giving Moses the law of clean and unclean animals. You can argue with Moses (and he with the children of Israel) over whether the hare chews its cud (I can hear the objections now: "But look at that hare. See it chewing its cud. You don't want me to believe my own eyes?"), or you can accept their judgment, and point out that it still doesn't change the bottom line. They still shouldn't eat hares. I think God wisely chose the second course. I would have had a great deal more difficulty if Lev 11:6 had said that hares split the hoof (an obvious falsehood) or that they were clean (a recommendation of inappropriate action based on the actuality of cud chewing and hoof splitting).

This principle is probably the major reason why Salman Rushdie's book *The Satanic Verses* upsets fundamentalist Moslems so. He calls attention to a reported episode when Mohammed proclaimed verses allegedly from the angel Gibreel (the Gabriel of the Bible) which he later (rightly) repudiated, saying that they were from Shaitan (or Satan). Rushdie's attempted explanation was that they actually came out of Mohammed's own head, as did all the other verses. This may or may not be a good explanation, but even using the most favorable explanation that accepts the story as accurate, it still is true that if Mohammed made that mistake once there is no assurance that he could not have done it again, and done it any number of times, only without it being detected during his lifetime. Put bluntly, for a time long enough to confuse his followers, Mohammed couldn't (or wouldn't) tell the difference between Gibreel and Shaitan, or at least between Gibreel and error. This would effectively destroy the authority of his visions. No wonder fundamentalist Moslems are upset.[16]

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[16]This would not mean that Islam is pure rot. There is a lot to be admired in Islam. Good Moslems should not drink, smoke, be promiscuous, or eat pork, and I find those prohibitions to be reasonable. Even the 5 pillars are not morally wrong. There is only one God, and Mohammed said a lot of true things, which therefore came from God somehow. If that makes him a prophet, then he was a prophet. Frequent prayers are a good thing. Giving to the poor is a moral requirement. A pilgrimage to places of religious historical significance is not wrong. And neither is fasting in the month of Ramadan. But if Mohammed made this central a mistake it would mean that even if Mohammed (or even the Qur'an) clearly taught the subordination of women, for example, we are not bound by his opinion. This may be another area where he unwittingly made a mistake.

Finally, inerrancy in all details should not be expected. If the purpose of revelation and miraculous and providential history is to influence people's major thought patterns and their actions, then it would be very surprising if some of the incorrect minor thought patterns were not incorporated into a revelation or historical account intact. One example is Lev 11:6, noted above. Another is Joshua 10:12,13 where Joshua commanded the sun to stand still, "and the sun stayed in the midst of heaven, and did not hasten to go down for about a whole day." We, who know that the Sun doesn't move relative to the Earth, but rather vice versa, know what the text is talking about, but to the ancients the text was not only phenomenologically accurate but scientifically accurate as well. God did not see fit at that time to correct ancient cosmology. There is an error here in the mind of the writer. That does not invalidate his authority as a witness.

C. S. Lewis illustrated it well. He knew of a girl who believed that poison had "horrid red things" inside, and that was what made it poison. Still, he said, that did not mean that he should disregard a warning she might give that something in her house was poison because of her prescientific concept of poison. He might very well die disregarding her because she had the important part right.

Another illustration may be helpful here. If you were in a primitive land and had a record or a tape of someone giving you information, you would not throw it away because it had "static", or even other voices. If the subject was sufficiently important, you might spend a great deal of time trying to sort out the extraneous noises, but you would listen to the voice you wanted very carefully. If someone tried to persuade you that there really was no voice there because he could prove that there were other noises,

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I did not discover how damaging *The Satanic Verses* was to Islamic theology until I read the book for myself. The western press that I was exposed to seemed to imply that there were only a few small areas where Muslims could take offense, whereas there are actually two whole chapters devoted to exposing the inconsistencies of Mohammed, and one of them bears the same title as the book.

The standard reply of Moslems to Rushdie's arguments is that the episode in question never happened. In their favor is that it was first recorded some 300 years later. In Rushdie's favor is that it was recorded by a devout Muslim as an apparently accurate oral tradition.

you would consider that the height of absurdity. Only if the voice itself were invalidated would you consider the recording worthless.

A perceptive reader may note that I have not used miracles as a criterion for accepting an authority. The reason why is that most religions teach that there is a Devil who is also capable of performing miracles. Thus although miracles may prove that a supernatural power is involved, they tell nothing about the identity or reliability of that power. That must still be determined on other grounds.[17]

I find the above approach to authority much more useful than trying to approach the problem by defining inspiration. For standard Christian doctrine has it that if something is inspired by God, then it must be true. And standard Christian doctrine also has it that "Every good endowment and every perfect gift is from above, coming down from the Father of lights . . ." (James 1:17). This means that if something is true, it is inspired in one way or another, and vice versa. Thus "inspired" becomes just another word for "true", and our discussion rapidly turns into a circular argument with no falsifiable premises. We still have to ask, "How do you know it is true (or inspired)?" (By this definition I hope this book is inspired!)

In the rest of this work, I intend to follow these principles of dealing with religious authority. Outside of general experience (including scientific experience), my primary source is the Bible. I will give a preliminary defense of that choice in the next two chapters. In the meantime, as long as the premises are clearly stated, you will be able to put proper weight on the conclusions reached from them.

It should be obvious that I do not believe in inerrancy. However, this does not mean that taking the Bible in this way has no

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[17]This approach to authority may be applied to the authority of personal impressions, dreams, and voices or visions. Sometimes one has a more or less distinct idea that one should follow a particular course of action which otherwise would not be recommended. Initial questions that should be asked include, "Am I being completely honest? (If I am not, does my impression, or whatever, go against my inclination or along with it?) How unreasonable is the course of action that my impression prompts me to take? Is it consistent with what I believe to be prior revelation? What are the stakes involved? Do I have any idea where my impression came from? How reliable have my impressions been in the past?" If none of the above questions can resolve the impasse, I think that the principle of conservatism should apply. In other words, trust your instincts. They just may be the voice of God.

consequences, or that I think that the authority of the Bible is limited to "religious" ideas. I think that there are some historical, scientific, and/or philosophical ideas which are so in conflict with Biblical authority that they can't both be right, and at this point I believe that the Bible has more authority in those areas of conflict.[18]

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[18]For Seventh-day Adventists, one last comment on Ellen White is in order. I take her seriously. However, I also take seriously her statements that "The Bible is the only rule of faith and doctrine", (FE 126— abbreviations used are those of The Ellen G. White Estate, Inc.: *Comprehensive Index to the writings of Ellen G. White*. Mountain View, CA: Pacific Press Publishing Assn., 1962), that she is "a lesser light to lead men and women to the greater light" (CM 125, Ev 257), that "If you had made God's word your study, . . . you would not have needed the Testimonies" (2T 605, repeated for emphasis in 5T 665, also LS198), and that "The testimonies of Sister White should not be carried to the front. God's Word is the unerring standard. The Testimonies are not to take the place of the Word. . . . Let all prove their positions from the scriptures and substantiate every point they claim as truth from the revealed Word of God." (Ev 256. Also compare CT 171 [CG 514], CSW 84, GC 204-5, 595, 2T 604-7, 5T 663-8, 6T 393, LS 200-1.) I take this to mean that our primary focus should be on the Bible. Thus I would far rather support a position by two Biblical passages than by twenty E. G. White quotations. Ellen White will primarily be mentioned when there is controversy about her position.

4

The Bible

The central events of the New Testament are the death and resurrection of Jesus of Nazareth. From our perspective, this may be the easiest place to begin. This is not where the Jews of Jesus' day began. For them, the Hebrew Bible was a given. The authors of the New Testament were mostly Jews (with the notable exception of Luke), and initially shared this perspective. But as they gradually moved out into the Gentile world, they came to realize that the Hebrew Bible was not authoritative for their listeners, and their sermons came to reflect that perspective. Compare the sermon recorded in Acts 13:16-41, which has 5 direct quotations from the Hebrew Bible as well as numerous allusions, with that recorded in Acts 16:22-31, which has no quotations from the Hebrew Bible, and 2 quotations from Greek poets. For that matter, compare the speech to the inhabitants of Lystra in Acts 14:15-17.

Today we have a similar problem, since the dominant religion in the intellectual world is scientific materialism, a form of empiric naturalism. Two major doctrines of this religion are that the ordering power of the universe is perfectly predictable if we just knew the rules, and that this power does not allow motives

to influence anything except as they cause us to interact with the physical world (*i. e.* there is no such thing as a miracle). The first doctrine justifies the principle of induction, for it postulates that the rules are always there and the basic ones are unchangeable, so if we always observe events to follow a certain course when we have accurate enough data to check on them, we may safely assume that they continue to follow that course even when we are not directly checking. The second doctrine is a special case of what we might call locality. That is, information can only be sent by physical particles, or perturbations of those particles, which can only travel at the speed of light, and usually travel much slower.[1]

Therefore according to scientific materialism any document that purports to describe a miracle must have some flaw in it. The Bible is such a document. It describes a miraculous creation, repeated communications between God and man, repeated miraculous events such as the Exodus, amazing coincidences such as the story of Esther, and then the story of Jesus. One can see why scientific materialism would relegate the Bible to the realm of fairy tales.

However, as we have seen in chapter 2, empiric naturalism cannot account for everything that has been discovered by science. The matter and energy we see in the universe are not eternal, give evidence of constant intervention from outside in the present, and have been influenced by at least one miracle. So we are not justified in rejecting the authority of a book because it reports other miracles. The Bible must be given a fair evaluation.

The data on the Hebrew Bible is relatively sparse, and is subject to some uncertainty. It is interesting to note some recent trends in archaeology and ancient history which indicate that the Hebrew Bible may be more accurate than previously thought, such as the vindication of many of the the historical details in the book of Daniel (see below). But in general, the reliability of the Hebrew Bible is not demonstrable enough to serve as a starting point.

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[1]This means that according to scientific materialism prayer is not heard and answered by an intelligent power that may decide on that basis to alter events elsewhere. Prayer may still be useful as a way to change our own psyche and thus our actions, and through changing our own actions it may effect changes elsewhere, but according to scientific materialism it cannot directly effect changes elsewhere.

Jesus was Resurrected

On the other hand, the life, death, and resurrection of Jesus are documented in sufficient detail to be used as a starting point for us. We will observe some of the testimony of His enemies. First, notice the charge that "He is possessed by Beelzebul, and by the prince of demons he casts out the demons." (Mark 3:22).[2] The charge is *not* that Jesus cannot heal blind people or cast out demons, or that He is a fake, but rather that the miraculous power is malevolent and not to be trusted. It is important to note that in Jesus' time his ability to work miracles at least some of the time was not challenged.[3] The enemies of Jesus conceded His ability to work miracles. They certainly would have liked to deny them (see John 9:13-34). We would need a good reason to go against them, and simply the fact that it goes against empiric naturalism is not an adequate reason.

Then there is the death of Jesus. All the extant ancient sources (Christian, Jewish, and pagan) were agreed on this point. As Festus summed up the issue to Agrippa, there were "certain points of dispute . . . about one Jesus, who was dead, but whom Paul asserted to be alive." (Acts 25:19) The event was witnessed by priests, soldiers, and "many of the Jews" (John 19:20), as well as several disciples. The writer of John takes pains to place himself as an eyewitness to Jesus' death and assures us that his testimony is reliable (John 19:35). In fact, other than that Jesus was known as the Christ (or Messiah), this fact is the only one for which we have testimony not only written but also preserved by His enemies (Tacitus, *Annals*, XV,44). The assertion that Jesus could have survived His flogging, crucifixion, and having a spear stabbed into His side ("*pleura*" in Greek), is frankly incredible, as has been pointed out.[4] The Romans were in the habit of making very sure that their victims were dead. At this point I see no reasonable hope of denying that Jesus died on the cross.

Finally, there is the resurrection of Jesus. The evidence for

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[2]See also Matt 9:34; apparently at the casting out of a dumb [Luke 11:15] and blind [Matt12:24] demon.

[3] His ability to work miracles on demand was challenged, but that is a different matter. See Matt 12:38,27:41-43; Mark 8:11,15:31-32; Luke 11:29,23:35; John 2:18.

[4]Edwards WD, Gabel WJ, Hasmer FE. "On the Physical Death of Jesus Christ". *JAMA* 255(11):1455-63, 1986

this may be divided into two parts. First, His body disappeared. Again, even His enemies agreed. The only explanation we have which is supposed to have come from them was that the disciples stole the body (Matt 28:11-15), a story which tacitly admits that they could not produce it, even when it would have been greatly to their advantage to do so. If the body could have been produced, they would have done it. On the other hand, the story was patently false. Even if one doubts that there was a guard posted at the tomb (Matt 27:62-66), a stone (apparently heavy and difficult enough to move that the women who first visited the tomb did not consider moving it themselves) was in front of the tomb (Matt 27:59;28:2; Mark 15:46;16:3-4; Luke 24:2; John 20:1). Their psychological state would have prevented them from carrying out such a plot. And they would never have given their lives for something *if they had known* it to be false.

Second, He appeared to many people after His death. Paul gives a partial listing in 1 Cor 15:5-8. Individual accounts can be found in the Gospels and Acts. Many of these people were already disciples, although none of them are recorded as expecting to see Jesus when they first saw Him. But at least two, James and Paul, were not disciples initially, and Paul was an avowed enemy when he first saw Jesus. I will agree that the appearances of Jesus do not provide coercive evidence of His resurrection by themselves. But in combination with the fact of His death and the disappearance of His body, I do not see any reasonable hypothesis other than that of His resurrection. Remember that the apostle Paul was able to tell Portius Festus that "the king [Herod Agrippa] knows about these things, and to him I speak freely: for I am persuaded that none of these things has escaped his notice, for this was not done in a corner." (Acts 26:26) The facts upon which Christianity was based were incontrovertible.[5]

It is ironic that the usual perception of non-Christians is that the story of the resurrection was made up to fit a theological theory in spite of the facts, when our best historical sources indicate precisely the opposite. The unexpected facts of the empty tomb

[5]For a thorough and cautious (sometimes overly so) evaluation of the evidence, see Wolfhart Pannenberg: *Jesus—God and Man.* Trans Wilkens LL, Priebe DA. Philadelphia: The Westminster Press, 1968. Others have also summarized the evidence, but usually not working around higher criticism. However, once the point is proven, a major premise of most of higher criticism falls.

and the appearances of Jesus forced the early Christians to re-evaluate their theology.

Jesus is Authoritative

If Jesus' resurrection happened, and the evidence seems coercive, it would follow that such an unusual event should have something important to say about the way our universe is put together. Thus the Gospels and the first part of Acts become important. They are our evidence as to the character of the event. And one of the important parts of the event is the character of the Man who was resurrected.

Again we will let His enemies speak first. During Jesus' trial before the Sanhedrin, an attempt was made to keep things as legal as possible. Many witnesses were called, but "their witness did not agree" (Mark 14:56). This implies that none of the witnesses were paid, or at least that they were subject to some semblance of cross-examination, or it would have been easy to trump up charges. But finally two witnesses testified, "'We heard him say, "I will destroy this temple that is made with hands, and in three days I will build another, not made with hands."' Yet not even so did their testimony agree." (verses 58-9) (Perhaps the second testimony was recorded in Matt 26:61, where Jesus was alleged to have said "I am able to destroy the temple of God, and to build it in three days.") It appeared to His judges that Jesus was going to go free on a technicality.

Now the points on which the witnesses agreed were that Jesus said A). He could destroy the temple, B). He could rebuild it, and C). it would take three days. Although His enemies wanted to believe it, point A does not fit with Jesus' life or teachings. But with the very slight shift from the Jerusalem temple to the temple of Jesus' body, and someone else destroying it, we have exactly the saying in John 2:19. John was not one of the synoptic writers, and there is no obvious reason why he should cover for Matthew and Mark, and certainly no reason they should copy him. It seems highly probable, then, that Jesus' enemies were acquainted with a saying of His that predicted His death and resurrection.

Thus the resurrection, in addition to being miraculous, also fit into a pattern of events that Jesus was expecting. This means that the claim that Jesus could not have predicted His death and resurrection is wrong, and if we find other similar predictions we

cannot automatically write them off to creations of the early church. We have to believe them unless we have good evidence to the contrary.

But there is more in this story. Jesus remains silent. Caiaphas, evidently on the verge of losing his only chance to get rid of this Troublemaker, resorted to adjuring Him "by the living God" (Matt 26:63): "are you the Christ [Messiah], the Son of the Blessed?" (Mark 14:61) Jesus could no longer remain silent. The law required Him to say what He knew. So He did. He agreed with the statement, and predicted His own coming again as well. Caiaphas finally had his charge. It was blasphemy for the Jews, and sedition for the Romans.

Some might be tempted to deny that Jesus believed that He was the Messiah, let alone the Son of God. But Caiaphas was obviously trying to be legal, and he had to have some charge on which to convict his Prisoner. If it was not what was stated, then what was it? I have not heard even a remotely plausible charge that could have been used to convict Him otherwise. And the entire narrative is not one that would have been made up by the early church. Not only were there too many people around who would have corrected the story if there had been any substantial error, but the narrative as it stands seems to hold Caiaphas out as one who would not stoop to buying false witnesses, or at least well-coached false witnesses, and who tried to make the proceedings as legal as possible. That portrait, although still flawed, is better than one that the early church would have made up on its own.

Now if Jesus believed Himself to be the Messiah and the Son of God, then we have no compelling reason to doubt that the other passages where He speaks of Himself as the Son, and speaks of God as the Father, are genuine. We also have no compelling reason to doubt that the passages where Jesus speaks of Himself as the Messiah are genuine. And if one grants that these passage are largely accurate, there is no *a priori* reason why any of the titles which Jesus is supposed to have used, such as the Son of Man, or the Way, or the Light of the World, could not be accurate. It becomes difficult to ignore such passages when searching for Jesus' self-consciousness.

The passage in John 10:22-39 stands out in this connection. Jesus claims to be the Messiah (v. 25). He again talks about "the Father" (vs. 25,29). Finally He declares, "I and the Father are

one" (v. 30). At this point the Jews take up stones to stone Him "for Blasphemy; because you, being a man, make yourself God." (v. 33) Jesus' defense is to quote the Hebrew Bible. "Is it not written in your law, 'I said, you are gods' [Ps 82:6]? If he called them gods to whom the word of God came (and scripture cannot be broken), do you say of him whom the Father consecrated and sent into the world, 'You are blaspheming,' because I said, 'I am the Son of God'?" (vs. 34-37) The psalm quoted is talking about heavenly beings (or at least superhuman beings) who are addressed as gods, and Jesus seems to be indicating that He is an even greater heavenly being. Personally, I have a hard time believing that John could have thought that one up on his own. I have an even harder time believing that he could have done so with a straight face.

The straightforward conclusion is that, although Jesus never claimed to be all there was to God, He saw an identity which set Him apart from His contemporaries. This leads to the well-known three choices. Either He was crazy (an opinion not unknown among His contemporaries), or He was an imposter who needs to be exposed, or He was what He claimed to be. The resurrection would seem to disprove the first alternative.

I have read the Gospels and the rest of the relevant New Testament passages, and I would say that the third alternative is by far the most likely. But if you have not done so, it would seem to be the logical thing to do to read them for yourself and form your own opinion. Just beware that you form your opinion on the basis of the evidence, and not on where you might be afraid that evidence will take you. After all, our journey is a search for truth, not for comfort, certainly not for immediate comfort.

The message of the Gospels is that Jesus' life, death, and resurrection have created a new reality (or have demonstrated reality to be different than previously thought). Therefore His words and actions have primary authority.

But what of the mass of higher critics of the New Testament? If this line of reasoning is correct, why didn't they see it? Why did they instead insist on the essential inaccuracy of the record as we have it today? The truth is that they started by trying to harmonize empiric naturalism and the New Testament. And since empiric naturalism can admit no exceptions to its rule of no miracles, they had to truncate more and more of the New Testament in order to harmonize it with empiric naturalism. Thus Jesus' miracles, and His resurrection, and any meaning to His

divinity which set Him essentially apart from His contemporaries, had to go. Many higher critics felt that if they could just get rid of this "husk", they could find a valid "kernel" in the life of a Jesus who was a great teacher, and a norm for our day, but who disclaimed any overtly supernatural pretensions. This first wave of higher criticism was dealt a serious blow when Albert Schweitzer recognized its bankruptcy and noted that even following its rules, he had to come to the conclusion that Jesus believed Himself to be the Messiah. Schweitzer felt that Jesus was wrong in His belief, because Schweitzer was himself a believer in empiric naturalism[6] (It is important to distinguish between empiric naturalism and some ethical systems which have sprung from it, such as those of Nietzsche and the Nazis, or Marx and the Communists, or that of what might be called the Social Darwinists in our society. One might very well believe in the theory that there is nothing beyond that can reach through space, time, and matter to us, without believing that one's chief end is to serve the self. Schweitzer obviously did).

The second wave was led by people who tried an even more strict methodology to remove any provably miraculous elements from the story of Jesus. Probably the most famous was Rudolf Bultmann, but there were a number of others. The arguments were made that the Gospels were written much later than previously believed, certainly not by disciples of Jesus.[7] They contained collections of stories which were mostly unreliable, having been made up by the early church to support its own position (or positions), and having been modified during, in some cases, more than 100 years of retelling. This has become standard theory for much of academia.

This theory has been dealt a serious if not fatal blow by one of its previous adherents, John A. T. Robinson. In his book *Redating*

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[6]For example, see this statement: "The dominant interest in the first [period] is the question of miracle. What terms are possible between a historical treatment and the acceptance of supernatural events? With the advent of Strauss this problem finds a solution, viz., that these events have no rightful place in the history, but are simply mythical elements in the sources. The way was thus thrown open. . . ." *The Quest of the Historical Jesus*, 1906. Translated by W Montgomery, 3rd ed. London: A. and C. Bleek, Limited, 1954, p. 10.

[7]Some of these arguments were also made by people in the first wave, but Mark was usually thought to be written relatively early and thus at least partly accurate.

the New Testament,[8] he showed that the assumptions behind the late dating of the New Testament were unsupportable and in many cases palpably false. In addition, crucial data, like the ending of Acts, were systematically ignored, with a blindness that was "almost wilful".[9] Neither he nor I see this as a complete vindication of fundamentalism. But it does mean that the New Testament, and particularly the Gospels, were written by people who lived through the times that they wrote about, and that they wrote at a time when mistakes could be pointed out by eyewitnesses. It may be granted that the stories were told orally many times before they were written down. But that means that idiosyncrasies are about as likely to be corrected as introduced. The basic reliability of the accounts is very likely and can be reasonably assumed.[10]

Remember that one of the basic assumptions underlying the mainstream of higher criticism, often stated explicitly, was that miracles can't occur. It may have been a reasonable belief at the time, but with the Big Bang, quantum correlations, and the origin of life staring us in the face, it is no longer tenable. Therefore the demand that miracles cannot be allowed, or even the suggestion that any other explanation of a phenomenon is preferable to a miraculous one, is unwarranted. So if we come across a miracle as well-documented as the resurrection of Jesus, we are justified in taking it at face value.

If we accept this miracle, there is no good reason for rejecting the observations of other miracles. If naturalistic explanations of those miracles are strained, rather than rejecting the story, we should accept the implication of a miracle.

This point of view makes the gospels particularly important evidence, and evidence that we cannot repeat at will. However much we may dislike certain features, like Matthew's doubling of people and summarizing, or Mark's ubiquitous "immediately" (*euthus*), or Luke's rearranging, or John's failing to mark where Jesus quits talking and his own editorializing takes over, they are the best, indeed almost the only, sources we have. They should be treated with utmost care.

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[8]Philadelphia: The Westminster Press, 1976.

[9]*Ibid.*, p. 342

[10]We probably have a copy of the book of Matthew from Egypt, written as a codex, which dates to around 70 AD. (Thiede CP: "Papyrus Magdalen Greek 17 (Gregory-Aland p64): A Reappraisal." *Zeitschrift für Papyrologie und Epigraphik* 1995;105:13-20). This puts extreme strain on any theory that would put the writing of Mark after 66 A. D.

The Bible is Authoritative

Actually, if one accepts in major outline the story of Jesus, the rest of the New Testament is not a major problem. There are very few miracles outside of Acts, and those are certainly not disproportionate to those in the life of Jesus. Again the line from source to writer is direct and straightforward. So again the rest of the New Testament can be taken pretty much at face value.

The Old Testament is a little harder. Jesus certainly seconded its validity,[11] including specifically the accuracy of Genesis 1 and 2,[12] Genesis 6-8,[13] Genesis 19,[14] Exodus 3,[15] Numbers 21,[16] 1 Samuel 21,[17] and 1 Kings 10,[18] the authority of Exodus 20,[19] Leviticus 19:18,[20] Deuteronomy 6:4-5,[21] Deuteronomy 17:6-7 and 19:15,[22] Psalm 82,[23] Psalm 118,[24] Isaiah 53,[25] Isaiah 56:7,[26] Isaiah 61,[27] Malachi 3:1,[28] and Malachi 4:5,[29] and the authorship of the Books of Moses,[30] Psalm 110,[31] Isaiah 29,[32] Jonah,[33] and Daniel.[34]

The only hint that Jesus gave that the Old Testament might not be reliable was his comment about Moses giving a divorce

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[11]Matt 5:17-19, Luke 16:17,31, John 10:35.
[12]Matt 19:4-5, Mark 10:6-9.
[13]Matt 24:37-39, Luke 17:26-29.
[14]Matt 11:23-24, Luke 17:28-32.
[15]Matt 20:31, Mark 12:22, Luke 20:51.
[16]John 3:14.
[17]Matt 12:3-4, Mark 2:25-6.
[18]Matt 12:52, Luke 11:31.
[19]Matt 19:18-9, Mark 7:10; 10:19, Luke 18:20.
[20]Matt 19:19; 22:39, Mark 12:39.
[21]Matt 22:37, Mark 12:28-30.
[22]John 8:17.
[23]John 10:34.
[24]Matt 21:42, Mark 12:10-1, Luke 20:17.
[25]Luke 22:37.
[26]Matt 21:13, Mark 11:17, Luke 19:46.
[27]Luke 4:17-20.
[28]Luke 7:27,32.
[29]Matt 11:14; 17:11, Mark 9:12.
[30]Matt 8:4; 19:8, Mark 1:44; 7:10; 12:26, Luke 5:14; 16:29-31, John 5:45-7; 7:19-22.
[31]Matt 22:43-5, Mark 12:36-7, Luke 20:41-4.
[32]Matt 15:8, Mark 7:6-7.
[33]Matt 12:39-41;16:4.
[34]Matt 24:15.

law "for your hardness of heart" (Matt 19:8, Mark 10:5). Even there He did not say that Moses didn't write the passage in question; indeed, He affirms that he did. He simply says that the law was not universal or even ideal but limited to a particular situation which was not ideal (one wonders how many other laws might fit into the same category).

Thus if you take Jesus' word for it, basically the entire Old Testament is reliable. To some, that would settle it. After all, given His life, Jesus does have more authority than the average person.

But suppose we do not wish to take Jesus' word for it, perhaps because we find it hard to believe the authority of some parts of the Old Testament. First, we must discount Jesus' opinion as being a product of His time. While doing this, we should not forget that our opinion is partly a product of our time, which is heavily influenced by empiric naturalism, which has been demonstrated to be false.

Then we should realize that there is a great deal of agreement between the two positions. Except for the second part of Isaiah, Jonah, and Daniel, the scholarly consensus is that the prophets were written by whom they say they were. The authorship of Job is disputed, but it makes little difference since the story is timeless.[35] The disagreements over Psalms are relatively minor, and the same goes for Proverbs, Ecclesiastes, and the Song of Solomon. There is disagreement over Esther, even though otherwise the feast of Purim is unintelligible. 1 and 2 Kings have been shown to contain remarkably accurate chronological data by Edwin Thiele.[36] Essentially all their historical data except the miracles are generally conceded to be accurate.

In fact, we are beginning to see a pattern here. All the Old Testament books that do not contain miracles are generally conceded to be accurate. Those containing miracles have been challenged. Sure enough, 1 and 2 Samuel and Ruth, and to a lesser extent Judges, are generally conceded to be mostly accurate,

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[35]Incidentally, the story must have been authoritative before Ezekiel, or at least the part about Job being righteous, as Ezekiel mentions it without further explanation in 14:14,20.

[36]*The Mysterious Numbers of the Hebrew Kings.* 3rd ed. Grand Rapids, MI: Zondervan Publishing House, 1983.

whereas the strongest attacks of the critics are reserved for Joshua and the Pentateuch, as well as Daniel and Isaiah.

This appears to be as much a conflict over theory as one over facts. Now of course most adherents of any given theory will characteristically deny that their theory influences their factual conclusions. Rather, they are driven to their theory by the facts. But they will usually see quite clearly that adherents of other theories ignore or misinterpret the facts.

We can't ignore theories. They do influence the kind of facts we believe are most important, and influence our search for new facts. Furthermore, they should. The thing that distinguishes good science is that theories are never allowed to become primary. So it is best to be explicit about our theories, but never hold them closer than the facts allow.

The theory that dominated the mainstream of Old Testament higher criticism was empiric naturalism. Thus miracles were to be explained away or their accounts turned into legends or myths, and the later they were written down, the easier this was to do. Accurate long-range prophecy was a miracle and was to be dealt with by putting its date of writing after, or at least near, the event prophesied. That is why most of the prophets (who contain relatively non-specific prophecies) were largely unchallenged, while Isaiah, Daniel, and Jonah were challenged.

Jonah can be expected to have left very few traces in secular history, and plausible although not coercive traces have been found, so one's belief or disbelief in the historicity of Jonah is simply a result of one's prejudices for or against miracles. There is very little argument over Jonah. Each side simply ignores the other.

But Isaiah talks about the sun going backwards in the sky, and predicts the reign of Cyrus the Persian. That is not allowed by empiric naturalism, and so Isaiah has to be attacked. Daniel also has miracles, especially the fiery furnace and the lions' den, and has detailed predictions of the future. So Daniel also has to go. And the Pentateuch and Joshua (sometimes known as the Hexateuch) abound in miracles and also have prophecies, so they have to go also.

But of course one cannot simply say, "Daniel has miracles, so Daniel has to go," and expect to win an argument with one who believes in miracles. If one is going to be competitive in the marketplace of ideas one has to find other reasons why Daniel is un-

reliable.[37] So prominence was given to the fact that Belshazzar was not known outside of the book of Daniel (and Baruch which was dependent on it), and that Nabonidus was recorded as the last king of Babylon by all the other known historians. Also Darius the Mede couldn't be identified (Cyrus the Persian was the first

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[37]There are many who will be startled to find that the mainstream of higher criticism did not discover that Daniel, and the Pentateuch, and other parts of the Bible were written at the (now) conventionally accepted times, and then switch from belief in orthodox Christianity to belief in empiric naturalism, but rather the reverse. Porphyry, the first to propose the Maccabean theory of Daniel, was a virulent enemy of all of Christianity (and Judaism). His theory was not revived until after the rise of scepticism and idealism. In like manner, Vatke, the originator of the current documentary theory of the Pentateuch, was a pupil of Hegel, and the first part of his book was a review of Hegelian philosophy. Speaking of Vatke's theory, Otto Pfleiderer says, "Later tradition was therefore wrong in representing the people under and after Moses as repeatedly sinking to a lower stage from a higher one already attained; on the contrary, the development was a gradual one in an upward direction amid a constant struggle between the two parties." *The Development of Theology in Germany Since Kant, and its Progress in Great Britain Since 1825.* London: Swan Sonnenschein & Co., 1890, pp. 255-6.

To get the flavor of the Hegelian view of history even more strongly, we may note Pfleiderer's praise of Wellhausen. ". . . a comparison of this new conception of Israelite history [Wellhausen] with the traditional one. There we had from beginning to end a series of riddles, of psychological and historical puzzles; here everything is comprehensible, we have a clear development, analogous to the rest of history, the external history of the nation and the internal history of its religious consciousness in constant accord and fruitful interaction; and though not an unbroken advance in a straight line of the whole people, still a laborious struggle of the representatives of the higher truth with the stolid masses, a struggle in which success and defeat succeed each other in dramatic alternation, and even failure only serves to aid the evolution of the idea itself in ever greater purity from its original integuments. This is human history, full of marvels and of Divine revelation, but nowhere interrupted by miracle or by sudden, unaccountable transitions.

"So bold an innovation necessarily provoked considerable opposition. This was often expressly, and perhaps still oftener silently, directed against what seems to us precisely the advantage of this new theory, viz. the substitution of a humanly comprehensible development for mysterious miracles and revelations. Since this opposition rests on dogmatic assumptions lying outside of history, it cannot determine the course of the historian." *Ibid.,* p. 274.

Or as was somewhat uncharitably remarked by someone on the other side, "They overlooked the historical fact that the disbelief had been antecedent to the criticism. Disbelief had been the parent, not the offspring of their criticism; their starting-point, not the winning-post of their course." Pusey EB. *Daniel the Prophet: Nine Lectures, delivered in the Divinity School of the University of Oxford.* London: A. D. Innes & Co., 1892, p. vi.

ruler of the Medo-Persian empire). The very first verse of Daniel was felt to be flagrantly in error because A. Jeremiah 25:1 stated that the fourth year of Jehoiakim was the first year of Nebuchadnezzar, so that Jehoiakim couldn't have been given into Nebuchadnezzar's hand in Jehoiakim's third year because Nebuchadnezzar wasn't king yet, and B. Jeremiah (v. 9) was felt to imply that Nebuchadnezzar had not invaded Judah yet, and there was no record of an invasion in Jehoiakim's third year other than the reference of Berossus, which was felt to be inaccurate.[38] Daniel and his companions couldn't be found in secular historians, or even (except for Ezekiel, which was discounted) in Biblical or intertestamental material before the time of the Maccabees. Their Babylonian names were felt to be corruptions which wouldn't have been butchered so badly if they had been from an actual account. The Aramaic of Daniel was similar to post-exilic Aramaic. Its Hebrew was alleged to be late. It had some Persian words, which were felt to indicate a date some time after the conquest of Cyrus. It had some Greek loan words, which were felt to prove a late date.[39] The theology of Daniel was felt to be too advanced for the Exile. Daniel was written in a style called apocalyptic, and our other examples (except probably Revelation and possibly Zechariah) were all pseudonymous. And Daniel is supposed to give detailed predictions of the Medo-Persian and Macedonian empires up to the time of Antiochus Epiphanes and is much more sketchy after that time. These arguments[40] bol-

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[38]It is strange how Berossus was felt to be inaccurate here when he was asserted to be strictly reliable when he stated that the last king of Babylon was captured some time after the city fell and was not killed. Apparently in the old style of arguing sources were to be used as a drunk would use a lamppost: more for support than for illumination. Unfortunately this went for both sides (see, for example, Hengstenberg EW. *Dissertations on the Genuineness of Daniel and the Integrity of Zechariah*. Trans Pratten BP. Edinburgh, T & T Clark, 1847).

[39]The classic statement of the arguments from linguistics was put this way somewhat later: "The *Persian* words presuppose a period after the Persian empire had been well-established: the Greek words *demand,* the Hebrew *supports,* and the Aramaic *permits,* a date *after the conquest of Palestine by Alexander the Great* (B. C. 332)." Driver SR. *The Book of Daniel. The Cambridge Bible for Schools and Colleges*. London: Cambridge University Press, 1900 (Italics his).

[40]And other minor ones. The judgment of Montgomery (himself a believer in the Maccabean theory) on the minor objections is pertinent: "The minor points should be approached from the judgment obtained for the main histori-

stered the claim of mainstream Higher Critics that Daniel was untrustworthy.[41]

Now there is nothing wrong with this way of proceeding. Everyone tries to find facts to support his or her theory. And at one time the evidence seemed to be heavily against Daniel. One could rationally put the origin of the book during the Maccabean period. In fact, quite a few theologians who apparently believed in miracles did so.

Defenders of the authenticity of the book of Daniel[42] did not have much to work with. The identification of Belshazzar with Nabonidus was very unsatisfactory. Darius was identified with the Cyaxares of Xenophon (*Cyropaedia* i-viii), who was otherwise unknown and whose existence was denied by Herodotus, or possibly with Gobyras, about whom little was known. Harmonization of Daniel 1:1 and Jeremiah 25 was attempted by saying either that Nebuchadnezzar was coregent with Nabopolassar or that Jeremiah used a different system of reckoning than Daniel (non-accession versus accession year reckoning or fall versus

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cal considerations, the questions of Darius the Mede, Belshazzar, the Fourth Monarchy. If the decisions fall out in favor of these points as historical, it remains for the historian but to discount minor difficulties and inaccuracies." Montgomery JA. *A Critical and Exegetical Commentary on the Book of Daniel. The International Critical Commentary*, Vol. 17. Edinburgh: T. & T. Clark, 1927, p. 72.

[41]For some examples, see Bertholdt L: *Daniel aus dem Hebräisch-Aramäischen neu übersetzt und erklärt mit einer vollständigen Einleitung und einigen historischen und exegetischen Excursen.* Erlangen: Johann Jakob Palm, 1806; Lengerke C von: *Das Buch Daniel.* Königsburg: Gebrüder Borntträger, 1835; and De Wette WML: *Lehrbuch der historisch-kritischen Einleitung in die kanonischen und apocryphischen Bücher des Alten Testamentes.* Berlin: G Reimer, 1845. A more complete list may be found in Barnes A: *Notes on the Old Testament, Explanatory and Practical. Daniel.* 1852. Reprint ed. Grand Rapids, MI: Baker Book House, 1961.

[42]For examples, see Hengstenberg in note 38; Hävernick HAC: *Commentar über das Buch Daniel.* Hamburg: Friedrich Perthes, 1832; and Barnes in note 40. Because some of the references in this and the previous note are both long (Bertholdt has over 800 pages) and in German, I have had to break my otherwise inflexible rule of not citing material unless I have read it, for these two notes. I can read German but with some effort, and am still wading through the material. However, the secondary material I have read is all consistent with what I have read of the primary material.

spring new year).[43] The Greek words were reduced to 3, but otherwise the best the defenders of Daniel could fairly say was that the linguistic evidence was inconclusive. The argument from theology, of course, was only strong for an empiric naturalist, and reversed itself for a supernaturalist.

There were four strong points for the defenders of Daniel. First, the four empires of Daniel 2 (later expanded by chapter 7 and chapter 8) seemed to include an empire after the Seleucids. The visions of Daniel 2 and 7 are obviously parallel, and almost all commentators would agree that the vision of Daniel 8 is parallel to the other two. We may list the parallels as follows:

Daniel 2	Daniel 7	Daniel 8	Identification
Head of gold	Lion with eagle's wings		Nebuchadnezzar (2:38)
Breast and arms of silver	Bear raised up on one side with 3 ribs in mouth	Ram with 2 horns, higher rose up last, pushing in 3 directions	Media and Persia (8:2)
Belly and thighs of bronze	Leopard with 4 heads and 4 wings	Male goat with one horn, then 4 horns Little horn? Sanctuary cleansed?	Greece (first horn = first king, then split into 4 kingdoms— 8:21-2)
Legs of iron	Terrible beast with iron teeth	Little horn?	Strong as iron, subdues everything (2:40)
Feet of iron and clay	10 horns, little horn	Little horn?	Divided kingdom (2:41) 10 kings, another king (7:24)
Stone	Judgment	Sanctuary cleansed?	God's kingdom (2:44) Judgment (7:26)

It may be questioned whether the little horn of Daniel 8 is identical with the fourth beast of Daniel 7, or with the little horn, or whether it comes before the fourth beast. But the ram with one horn higher than the other appears to be the same as the bear which was raised up on one side, and the leopard with 4 heads (the only animal with more than one head) and 4 wings appears to be the same as the male goat with the one horn whose place was taken by 4 horns. I see no reasonable way around that identification.

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[43]Both hypotheses about the year turn out to have some truth. There were two different kinds of year, and accession-year reckoning was used. The former probably accounts for the discrepancy. We now have Nebuchadnezzar's annals which confirm Berosus. See Thiele, note 36.

The most common way to have the fourth beast be the Seleucids, the theory that Daniel envisioned a separate Median kingdom, is ruled out by the book itself. In 8:20, the kingdom of Media and Persia is represented by one animal (the ram). During Belshazzar's feast the word Parsin or Peres (the word itself implies Persian predominance) is interpreted as standing for the Medes *and Persians* (5:28). And in 6:8,12,15 Darius the Mede is bound by the laws of the Medes and Persians.

If the bear is the Medo-Persian empire, and the leopard is Greece with its four divisions, then the fourth beast (to say nothing of the little horn) had to come *after* the Seleucids, and Daniel's prophecies did not end shortly after 164 B. C. as required by the empiric naturalistic interpretation. Then the fourth beast could easily be Rome, where it naturally fits. But if Daniel made some accurate predictions, he could have made some more, and there is no *a priori* reason why his prophecies couldn't have been made in the 6th century rather than in the 2nd.

Second, the seventy weeks of Daniel 9 extended past the Maccabean era. It is nearly universally agreed that these weeks (9:24—literally sevens) must be weeks of years. The number is reinforced in 9:25-7 by being given in parts, one of which, the 62 weeks, does not have any discernable symbolic significance. For the present I have no intention of getting stuck in what has been called "the Dismal Swamp of O. T. criticism".[44] I only wish to make one point. Regardless of which decree to rebuild Jerusalem (or the Temple—around 537 B. C., 520 B. C., 457 B. C., or 445 B. C.) one selects, there is no reasonable way to get to the Maccabees, or even to suggest how the writer of Daniel could have mistakenly done so. The 70 weeks have to extend beyond the Maccabean period. Since this prophecy and the fourth kingdom extend beyond Antiochus Epiphanes, it is not proper to say that all the prophecies point to Antiochus or even his era. The 70 weeks did not end until some 100-200 years later.

Third, the Maccabean theory of Daniel strongly implied a practically complete acceptance of a thoroughly erroneous book into the canon within less than 60 years of its writing. Everyone at that time agreed that the writer of 1 Maccabees (and possibly Mattathias) and all the subsequent writers who mentioned the subject (except Porphyry) until the Renaissance accepted Daniel

[44]Montgomery, see note 40, 17:400.

as canonical, including Jesus, Josephus, and John the Revelator, as well as the subsequent Jewish writers. This factor has not always been given the weight it deserves. On the Maccabean hypothesis, Daniel, and certainly the prophecies, didn't exist before 167-4 B. C., and yet within perhaps 30 years the writer of 1 Maccabees accepted the book. If the prophecies had been both new and obviously partly wrong, and the Jews of that period lacked a prophet to say what should be done about defiled stones (1 Macc 4:46), let alone books of the canon, it is difficult to see how the book could have become canonical.

Finally, the reference to Daniel in Ezekiel (14:14,20;28:3) was not easily explained without the story being correct. On this point the proponents of the Maccabean theory were not quite objective. One of their major arguments was that there was no external evidence for the existence of Daniel before 1 Maccabees, and yet the one other book of the Bible which was written in Babylon at that time mentions a Daniel who had not been otherwise satisfactorily identified. Daniel does fit in terms of his qualifications after Daniel 2 (righteousness, Ezek 14:14,20, and wisdom, Ezek 28:3). It is not fair to dispose of this piece of evidence on shaky grounds and then say that the lack of external evidence is a good argument against the authenticity of Daniel.

The argument that since Job and Noah were ancient, Daniel must be, seems strained. No one would have trouble identifying the middle member of the trio of great generals if we listed Caesar, Napoleon, and Alexander the Great. Nor would anyone have any trouble identifying the common properties of Nero, Hitler, and Atilla the Hun. There is a reason why Daniel might have been mentioned in the middle. Noah, by his righteousness, saved his whole family. Daniel, by his righteousness, saved himself and his companions. But Job couldn't save any of his children by either his righteousness or his prayers (although he did save his friends). If the argument was meant to say that Daniel doesn't fit perfectly, then I could accept it. However, it seems that he fits well enough so that the weight of evidence from this passage is on the side of the conservatives. Ancient commentators had no trouble with this identification. And it is noteworthy that people with a knowledge of the Hebrew Bible would have instantly known who Noah and Job were, and yet on the Maccabean theory of Daniel they would have been completely in the dark about Daniel, of whom more was said. The detractors of Daniel should have

realized, or shown they realized, that on this point they were going against the weight of evidence. They may have been justified by other considerations, but on the external evidence their arguments should have been clearly defensive.[45]

But most of that has changed. Belshazzar has been found, as second ruler of Babylon, being given the kingship,[46] and able only to offer Daniel the post of third ruler in the kingdom, which was precisely what he offered in Daniel 6.[47] A possible candidate for Darius the Mede has been found in Cyrus himself.[48] Not only

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[45]It is true that we have now found a Daniel (with the spelling actually matching that of Ezekiel slightly better than Daniel of the book but whose wisdom and righteousness are no match for Ezekiel's Daniel) in Ugaritic literature. This is the one prediction of the early detractors of Daniel that has at least partially come true. But even if we assume that Ezekiel would take an example from pagan literature, the early detractors of Daniel didn't know that this Daniel existed and couldn't have used that argument.

This is not to say that they are the only ones who are unable to look objectively at the evidence, or even the first. The tone of the early defenders of Daniel is often every bit as polemic, and their understanding of their own weaknesses and their opponents' strengths were often as limited as that of their opponents. It is to be hoped that we can improve on the lack of objectivity of that era.

[46]See Oppenheim A. L., in Pritchard JB (ed): *Ancient Near Eastern Texts Relating to the Old Testament.* Princeton, NJ: Princeton University Press, p. 313. See the discussions in Dougherty RP: *Nabonidus and Belshazzar.* New Haven: Yale University Press, 1929; and Shea WH. "Nabonidus, Belshazzar, and the Book of Daniel: an Update." *Andrews University Seminary Studies (AUSS)* 20(2):133-49, 1982.

[47]The expression "third ruler in the kingdom" puzzled the early commentators. For dramatic effect it would have been better to make the interpreter the second ruler in the kingdom, as Joseph was. Solutions offered included triumvir, third after the king and queen (or queen mother), and third after the king and king's son (! See Barnes, note 40, 1:291, after Grotius) or "heir apparent" (Henry M: *Matthew Henry's Commentary on the Whole Bible.* New York: Fleming H. Revell Co., 1712). Of course, after the discovery of Belshazzar in the secular documents, the meaning was obvious (but not immediately—see Keil CF: *The Book of the Prophet Daniel.* 1869. Trans. Easton MG. Edinburgh: T. & T. Clark, 1872) to all but die-hard detractors, who have latched onto an Akkadian word meaning third-rank officer. But imagine Belshazzar trying to bribe the wise men with what was in effect a demotion for some of them. "I'll put a royal robe on you and put a gold chain around your neck and make you a district manager, or major in the army." This one piece of information proves that the writer of Daniel knew more about the last days of the Babylonian kingdom than anyone else except the monuments themselves.

[48]A number of other suggestions have been made, such as the governor of Babylon during Cyrus' time, Gubaru by name (see Whitcomb, J. C. Jr. *Darius*

has Daniel been found (under his Babylonian name of Belteshazzar (= Belshazzar),[49] but his three Hebrew friends have been plausibly identified on a cylinder suggesting a political gathering similar to if not identical with the one recorded in Daniel 3.[50] Aramaic documents from about the time of Daniel have been found, and except for spelling, the book of Daniel matches them more closely than it does later documents.[51] Even the spelling in

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the Mede. Grand Rapids, MI: Wm. B. Eerdmans Publishing Company, 1959), and Gubaru or Ugbaru (probably Cyrus' general Gobyras—see Shea, W., "Darius the Mede: An Update." *AUSS* 20(3):229-47, 1982). But they all have weaknesses which leave me unconvinced.

Donald Wiseman was the first to suggest that Darius was actually Cyrus ("Some Historical Problems in the Book of Daniel", in *Notes on Some Problems in the Book of Daniel*, Wiseman DJ, ed. London: The Tyndale Press, 1965, pp. 9-16). As he presents them, the arguments for this position are relatively weak, but they have been strengthened by William Shea ("Darius the Mede in His Persian-Babylonian Setting." *AUSS* 1991;29(3):235-257) who points out that there is evidence that Cyrus became king of Media before he took the formal kingship of Babylon late in the first year after he conquered it (his son Cambyses was king during most of his first year). Shea also deals with the *gestalt* of the period in a way that I find satisfactory, and the only thing I am waiting for before I can completely support this theory is the finding of a Darius in the Median documents of this time. This still remains the weakest link in the arguments for the historicity of Daniel.

It must be said that the theory that Darius the Mede was a figment of the writer's imagination has nothing positive going for it either. A separate Median kingdom is excluded by the text, and would have weighed heavily against the acceptance of a newly published book as canonical if it was not already accepted by the Jews of Maccabean times.

Outside of this supposed Median empire, I have not seen any reason given for the invention of Darius the Mede. Thus Darius is not as strong an argument against the historicity of the book as might seem at first glance.

[49]The documents are translated in Dougherty, see note 46, p. 67-70, and (into German by) Oberhuber K: *Sumerische und Akkadische Keilschriftdenkmäler des Archäologischen Museums zu Florenz.* Innsbruck: Innsbrucker Beiträge zur Kulturwissenschaft, Suppl. 8, 1960, p. 95 (no. 135). The latter is cited by Brinkman J: "Neo-Babylonian tablets in the Florence Museum." *Journal of Near Eastern Studies* 1966;25:202-9. See the discussion by William Shea in "Bel(te)shazzar meets Belshazzar", *AUSS* 26(1):67-81, 1988.

[50]The document is translated by Oppenheim, see note 46, p. 307-8. See the discussion by William Shea in "Extra-Biblical Texts and the Convocation on the Plain of Dura", *AUSS* 20(1)29-57, 1982.

[51]See the discussion in Kitchen KA: "The Aramaic of Daniel", in Wiseman, see note 48, pp 50-79.

the book is characteristic of a time before the Maccabean period.[52] The Persian words turn out to be Old Persian, which mostly disappeared by 300 B. C.[53] The surprise about Greek loan words is now not that Daniel contains them, but that it contains so few.[54] It even appears that the writer of Daniel knew on which day of the week the new year fell during the third year of Cyrus.[55] And perhaps most stunning, copies of the book of Daniel have been found in the Dead Sea Scrolls (including the change from Hebrew to Aramaic and the change back from Aramaic to Hebrew), and if it were not for the fixed "knowledge" of the dating of the book, one of them would probably be dated earlier than Daniel was supposed to be written. As it is, this manuscript is dated to less than 50 years after the time of the supposed writing, and we are told that we must be in possession of one of the first copies![56]

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[52]This forces those who believe in the Maccabean theory to hypothesize that the Massoretes overcorrected the spelling. See Cross FMJr, Freedman DN: *Early Hebrew Orthography: A Study of the Epigraphic Evidence.* New Haven, CT: American Oriental Society, 1952. On pp. 69-70 they stated, "The later parts of the Old Testament seem to have been revised systematically on the basis of the conservative spelling practices of the Pentateuch manuscript tradition, as is evident from the fact that the latest books (Daniel, for example) were put into orthography which is actually older than the date of the writing of the books itself!"

[53]See Kitchen, note 50, pp. 35-44,77. Three of these words were badly translated by the LXX/Theodotion, suggesting that their meaning had been lost between the writing of that part of Daniel and the translation of the Septuagint.

[54]See note 50, pp. 44-50,77, and Mitchell TC, Joyce R, "The Musical Instruments in Nebuchadrezzar's Orchestra", in Wiseman, see note 47, pp.19-27.

[55]See the discussion by William Shea in "Wrestling with the Prince of Persia: A Study on Daniel 10." *AUSS* 1983;21(3):225-50.

[56]The oldest manuscript is published in Ulrich E: "Daniel manuscripts from Qumran. Part 2: Preliminary editions of 4QDan^{b} and 4QDan^{c}." *Bulletin of the American Schools of Oriental Research* 1989;274:3-26 (BASOR). The paleography is discussed in Cross FMJr: "The development of the Jewish scripts." In Wright GE (ed): *The Bible and the Ancient Near East.* Garden City, NY: Doubleday & Company, Inc.,1961 (*BANE*).

Cross says that some features which occur in 4QDan^{c} are relatively old, such as the simple *zayin*, the long thin final *mem*, the small "y" *ʿayin*, the narrow, round-shouldered *reš*, and the use of the two-stroke *taw* part of the time. Some are younger, such as the narrow *he* with parallel legs, the simplified *yod* nearly matching *waw*, the two-stroke *kap*, and the curved *sin* with the right arms formed with one stroke. Cross fit it after 4QXII^{a} (a manuscript of the twelve minor prophets) and at the same time as 4Qps-Enoch^{a} (a manuscript thought to be of pseudo-Enoch).

Cross first gave the manuscript the earliest 'possible' date, in "the late second century [B. C.]", "no more than about a half a century younger than the

None of this evidence appears to be reversible. It would seem that the writer of Daniel had inside information about the politics of the Babylonian and Medo-Persian empires which had been lost by all other sources by 164 B.C. He was also able to write in a style which was archaic for 164 B.C., and put in just the right amount of Greek words. Except for the miracles and prophecy (and we have discussed that problem above), Daniel would appear to have to have been written when and by whom it says it

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autograph of Daniel." (Cross FMJr: *The Ancient Library of Qumran and Modern Biblical Studies.* Revised ed. Anchor Books. Garden City, NY: Doubleday & Company, Inc., 1961, p. 43). He then backpedaled to around 75 B. C. in *BANE*. He then was forced to reinstate the earlier date (see Ulrich, BASOR, p. 18), apparently because of the discovery of documents of the time of Alexander from the Wadi ed-Daliyeh (Cross FMJr: "The papyri and their historical implications." In *Discoveries in the Wâdi ed-Dâliyeh.* Cambridge, MA: American Schools of Oriental Research, 1974, pp. 17-29).

Further evidence for this early date is given by Ulrich (BASOR, p. 18) with three additional characteristics of the handwriting which appear to be relatively archaic. First, some examples of *bet* have the initial downstroke come so far down that it closes the left side of the letter. Second, a partial example of *tet* suggests the older form (without the square corner on the right?). Third, some examples of *ʿayin* have the right stroke nearly vertical.

But the matter is even more complicated than that. The entire paleography sequence was floating from 375-350 B. C. to 55 A. D. That is, in this interval it gives only relative dates. Cross' dates in *BANE* are based on the assumption that changes in the standard handwriting occurred in two phases. He remarks on "the emergence from the slowly evolving Archaic book hand of a characteristic and rapidly developing style, which may be associated naturally with the decline (or suppression) of Greek, the resurgence of Aramaic and especially Hebrew as the official languages of Judaea in the era of Maccabean nationalism." This assumption helped ease the strain on the Maccabean theory of Daniel by giving a later date for the oldest fragment of Daniel. But it turned out to be at least partly wrong when measured by the fixed dates of the documents from the Wadi ed-Daliyeh. And it is just as easy to visualize a period of rapid change in the early Greek period, followed by a period of relative ossification in the conservative climate of the Maccabees, as the reverse. Perhaps the truth is somewhere in between. The manuscript might easily be older than the Maccabean theory of Daniel would allow.

In addition, what is not always properly noted is that several characteristics of 4QDan^{c} are highly individualistic, or as Cross would say, "ephemeral" (*BANE*, p.187). These include the leftward curl of the bottom of the diagonal in *ʾalep*, the use of final *mem* in the medial position, the absence of most final forms of letters (exceptions are *kap*, *nun*, and possibly *sade*), and the closure of the head of *pe*. If 4QDan^{c} is so individualistic in these characteristics, it would seem possible that some more 'modern' features are also merely individualistic features that were later adopted by other scribes, rather than indications of modernity. This manuscript may belong earlier in the sequence than it appeared at first glance.

was. Even the fallback position that someone took an old story and added or reworked the prophecies would seem to be a strained position.

Using the terminology of Lakatos (see chapter 1), it is fair to say that the Maccabean theory of Daniel is a degenerating research program, and that the conservative theory of Daniel is a progressive research program. It would seem prudent to strongly consider the more progressive program.

This dramatic turnabout in the arguments over the book of Daniel would seem to indicate caution about disregarding other books of the Old Testament. In fact, it would seem reasonable to explore theories attempting to harmonize them with secular history without largely discounting them. This approach may not prove fruitful in the end, but it deserves as much of a try as the approach which discounted all miracles was given. At this point I shall make such an attempt. I will not claim that all of the presently available evidence is coercive, or even persuasive. But it

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Of course, to one who is convinced of the Maccabean theory of Daniel, none of this makes any difference. The manuscript cannot be older than 164 B. C., and that is all there is to it. Any evidence to the contrary must simply be explained away. This is particularly true since 4QDan^{c} happens to quote Daniel 10 and 11, which simply have to be fabricated after the event unless there is such a thing as accurate prophecy. Accurate prophecy would be an almost unanswerable argument for a God who could intervene in history. So if one is committed to the universe as a closed system, without the intervention of God, no amount of evidence will be convincing. But if one recognizes that the universe is not a closed system, then the manuscript suggests that one of God's interventions was either to produce the book of Daniel, or to conform history to its predictions (or both).

Today we may not have to leave the question there. With modern techniques for radiocarbon dating (see the next chapter for a discussion) one does not have to destroy the entire manuscript to date it by physical means. This should be done (in fact, most of the Dead Sea Scrolls should be dated by the carbon-14 method, so we have some relatively firm hooks on which to hang our chronology. It would be particularly fascinating to date the paleo-Hebrew manuscripts of Leviticus). This would still not prove the point for Daniel (as it might for Leviticus), unless it was written before around 225 B. C., as we will get a range of dates rather than a single date (partly because of statistical difficulties and partly because of the radiocarbon calibration curve: See Stuiver M, Becker B: "High-precision decadal calibration of the radiocarbon time scale, A.D. 1950-6000 B.C." *Radiocarbon* 1993;35 (1):35-65, and Pearson GW, Stuiver M: "High-precision bidecadal calibration of the radiocarbon time scale, 500-2500 B.C." *Radiocarbon* 1993;35 (1):25-33) But if the range is centered at a point older than 164 B. C., it would put some strain on the Maccabean theory of Daniel.

does have the advantage of not having to assume Jesus was mistaken when He used the Old Testament.

If one allows for the possibility of miracles, Isaiah can be accepted as authoritative relatively easily. The mention of Cyrus becomes merely another example of accurate prophecy. Something happened to stop Sennacherib from conquering Jerusalem. Since Daniel did not write everything only for the people of his day, there is no reason to demand that Isaiah do so either. The only problem is that the sun going backwards at the time of Hezekiah's illness is not documented in secular sources which are usually assumed to be contemporaneous. This may be an artifact of not enough people looking in the right places.

Job can be expected to leave few traces in history. The only traces that might be left would be a reference to the story in other sources. Indeed, Ezekiel mentions Job. So once miracles are allowed, there is no good reason to doubt the veracity of Job.

Esther fits into a relative void in history. Outside of miracles (and strictly speaking not even miracles but only providence), there are no persuasive arguments for or against Esther, other than the feast of Purim itself. As a first approximation, we can assume its historicity.

The historicity of 1 and 2 Kings (and therefore 1 and 2 Chronicles), and especially their chronological data, has been confirmed, as noted above. Therefore, once miracles are allowed, there is no good reason for doubting their historicity. Judges and 1 and 2 Samuel and Ruth would follow suit.

That leaves us with Joshua and the Pentateuch. Here we have three problems that must find some kind of solution before the entire Old Testament can be accepted as authoritative. First, there are the allegations of the late date of the Hexateuch. Second, there is the difficulty of finding the Exodus and the conquest in secular (particularly Egyptian) history. And finally, there is the difficulty that the theory of evolution poses to the credibility of Genesis 1-11. We will discuss these questions in the next chapter.

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The Pentateuch and Joshua

The three questions which closed the last chapter are actually closely interrelated. For if Moses wrote the Pentateuch, then he certainly would have had access to the correct information concerning the Exodus, and it is reasonably probable that his information on Creation and the Flood are accurate as well. Also, if the information on Creation and the Flood and the Exodus are accurate, there is no good reason to deny the Mosaic authorship of the vast bulk of the Pentateuch. On the other hand, if the Pentateuch and Joshua were written late, there is little reason to expect them to be accurate, and if they are inaccurate, it is virtually certain that they were written late.

It may surprise some, but I think the easiest approach for now is to deal with the question of the historicity of Genesis 1-9 and its relation to the theory of evolution.

Evolution, Creation, and the Flood

Numerous attempts have been made to relate the early Genesis account to the theory of evolution. These can be divided into four groups. First, there is *mechanistic evolution.* This theory holds that the universe and life in it evolved by purely naturalistic means, without any outside interference. In this view the geologic column represents millions of years of time (currently felt to be 4.3 to 4.5 billion years total, of which 550 to 600 million years, called the Phanerozoic, have undisputed traces of life). The adherents of this theory commonly hold that the early Genesis account is entirely mythical and thus unreliable.

Second, there is *theistic evolution.* This theory holds that mechanistic evolution is essentially correct except that at certain points (or perhaps continually) God helped the process along a little. This theory usually deals with the early Genesis account in a manner similar to, but not usually quite as harsh as, mechanistic evolution.

Third, there is the theory of *multiple creations*, which holds that there was a creation, or multiple creations, over a period of millions of years. These successive creations are usually thought of as being destroyed catastrophically, creating the geologic column. Then a few thousand years ago, there was a special creation and a fall, whose details more or less fit those of Genesis 1-3. From the multiple creations viewpoint the Flood is usually interpreted as a local phenomenon that did not leave any unequivocal traces.

Finally there is *special creationism*,[1] which holds that God created a chaotic world and then created life on it for the first time a few thousand years ago. In this view the geologic column (more properly the Phanerozoic to at least the Cretaceous and possibly to the Pleistocene) is the result of the Biblical Flood. What happened before creation week is not completely agreed upon. Our planet may have been created on the first day, or it may have been in a chaotic state for millions of years before creation week. The same holds true for the stars outside our solar

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[1]The term originally came from the idea that God created each individual species as it is today, but by now has evolved (pardon the expression) into the definition given in the text, with the term "special" becoming less technical and more an expression of a specific unique supernatural intervention.

system. From the point of view of modern physics, this distinction may not matter, as the aging of the universe without observers is in one sense irrelevant.[2]

The first alternative, mechanistic evolution, appears at this point highly unlikely to be correct. As we have noted in chapter 2, mechanistic evolution has no explanation for the origin of life. The evidence we have indicates that this problem is becoming more acute rather than less so.

There are a number of other criticisms of "evolution" which are actually criticisms of mechanistic evolution. For example, there is the problem of the "missing link". For almost all phyla the problem is actually a missing chain—*all* the links are missing. Stephen Jay Gould's "hopeful monsters" might as well be relabeled "miracles". One of the few testable predictions Darwin made was that intermediate forms would be found as the geologic record was more fully examined. At present this prediction appears to be dead wrong. Then there is the problem of evolving complex structures like the eye—and not just once, but twice (squids, octopi, etc., and vertebrates). Such problems make it reasonable to discontinue consideration of mechanistic evolution until more evidence compels its re-evaluation. This is in spite of the fact that it and special creationism are the two most satisfying positions from a theoretical point of view (the most elegant).

But none of the foregoing objections touch either theistic evolution or multiple creations. For if God was there to help the process, in whatever way He did it, then the fact that it was a miracle would not prove theistic evolution or multiple creations wrong, and in fact is not unexpected. Hence the above arguments fall well short of proving special creation. Therefore we must use

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[2]As a logical option, the day-age theory can be ignored. It is neither Biblical (the days in Genesis 1 had an evening and a morning) nor is it adequate to explain the geologic column (for example, the reptiles of the 6th day precede the birds and whales of the 5th day in the geologic column). It is a hybrid born of desperation.

All of the above theories accept minor evolutionary changes (sometimes called microevolution) today. Only mechanistic evolution and one brand of theistic evolution wholeheartedly accept large evolutionary changes (macroevolution). Nobody knows the precise line to draw between microevolution and macroevolution, except that macroevolution would bridge the gap between the phyla and between the classes, and between other animals and humans, while microevolution does not. Therefore differentiation between these theories on the basis of macroevolution is not as useful as it would seem at first.

another approach to decide which scenario is most likely.

We should now note the major advantages and disadvantages of the three remaining groups of theories relative to each other. Theistic evolution has the advantage of not having to challenge the scientific evidence for long ages of earth's history. It is also able to incorporate any evidence for macroevolution, and yet is not mechanically dependent on macroevolution. However, it must deny the historicity of the Genesis creation and flood accounts (and thus must assume that Jesus' theology was incorrect, which is difficult if Jesus was really the Messiah). It is also basically an *ad hoc* theory. It can accomodate almost any evidence, which from a theoretical point of view is a disadvantage. One would prefer a theory which had more predictive power.

On the other hand, special creation has a great deal of predictive power, and allows for the historicity of the Genesis creation and flood accounts, making it an elegant theory, on a par with mechanistic evolution. However, it must deny the validity of the standard arguments for the existence of life on the earth for millions of years (it bears repeating that special creation may allow for our planet, and the stars, to be in this age range. It is only when unmistakable fossils exist, usually believed to be in the Cambrian, that the difficulties become acute).

The multiple creations model is a compromise. It allows life on the earth to be as old as usually believed, while at the same time being more or less faithful to the Genesis creation account. This has some theological advantages; it can allow Jesus' theology, and Paul's theology, to be more accurate than can theistic evolution, as Jesus' theology makes use of the Genesis account of creation, and Paul's theology depends on the Fall.

However, the multiple creations model is unable to find any traces of a Flood in the geologic record. It is thus in the awkward position of insisting on the basic historicity of Creation and the basic nonhistoricity of the Flood.[3] The multiple creations model therefore does not completely exonerate Jesus' theology, as Jesus also makes use of the Flood as a parallel to the time of His second

[3]Remember that according to the Genesis account the flood is supposed to have lasted for a year. Noah is supposed to have built a large boat in preparation and supported a veritable zoo. Perhaps most striking, the boat is said to have landed in the mountains of Ararat. This implies an event of global scale. If there are not obvious geological evidences of such an event, then it is wildly exaggerated if not fictitious. Theology based on a non-existent event is baseless.

coming. The insistence on a Creation and a Fall for what are essentially theological reasons while denying another theologically significant event in the same document because this time it is scientifically testable seems incongruous to me. Thus I see the multiple creations model as theoretically the least satisfying option, an option to be used only if we must eliminate both theistic evolution and special creation from the competition.

So for now we can attempt to choose between theistic evolution and special creation. It should be noted that with the disappearance of mechanistic evolution[4] this is no longer a choice between science and religion (it does, of course, have scientific and religious repercussions). Both theories postulate a God Who intervenes. Both theories claim that they can explain the scientific evidence if given enough research. What this dispute is actually

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[4]In fact, even mechanistic evolution may not fit some of the more important qualifications of a scientific theory. Karl Popper had trouble with the scientific aspect of mechanistic evolution as noted in the following passages:

". . . I intend to argue that the theory of natural selection is not a testable scientific theory, but a metaphysical research program; and although it is no doubt the best at present available, it can perhaps be slightly improved." (Popper KR: *Unended Quest: An Intellectual Autobiography.* Glasgow: William Collins Sons & Co. Ltd., 1976, p. 151)

"It is metaphysical because it is not testable." (p.171)

". . . it suggests the existence of a mechanism of adaptation, and allows us even to study in detail the mechanism at work. And it is the only theory so far which does this.

"This is, of course, the reason why Darwinism has been almost universally accepted. Its theory of adaptation was the first nontheistic one that was convincing; and theism was worse than an open admission of failure, for it created the impression that an ultimate explanation had been reached.

"Now to the degree that Darwinism created the same impression, it is not so much better than the theistic view of adaptation; it is therefore important to show that Darwinism is not a scientific theory, but metaphysical. . . ." (p. 172)

Popper did see one prediction, and therefore a possible scientific test of evolution: "Gradualness is thus, from a logical point of view, the central prediction of the theory. (It seems to me that it is its only prediction.)" (p. 172)

Thomas Kuhn also noted that it is difficult to derive testable conclusions from mechanistic evolution. When discussing his differences with Karl Popper, he noted that a modified Popperian approach might be that "For a field to be a science its conclusions must be *logically derivable* from *shared premises*. . . . But in this form, at least, it is not even quite a sufficient condition [for a field to be a science], and it is surely not a necessary one. It would, for example, admit surveying and navigation as sciences, and it would bar taxonomy, historical geology, and the theory of evolution. The conclusions of a science may be both precise and binding without being fully derivable by logic from accepted premises." (*The Essential Tension,* Chicago, University of Chicago Press, 1977, p. 250, n 21, italics his)

over is history. What matters is not what **should** happen, or what **could** happen, but what **did** happen.

Once the dispute is seen in this way, two considerations come to the fore. First, the early Genesis account taken at face value purports to be historical, and therefore should not be ignored until it has been shown to be false. Special creation gains an edge (possibly a slight edge, but an edge) in the discussion, since there are no early historical documents supporting theistic evolution. Second, chronology is the backbone of history. And the essential difference between the two theories (other than their theological implications) is time. In this case absolute physical and chemical dating methods (primarily radiometric dating) are the backbone of chronology from a theistic evolutionary point of view (or any other point of view espousing a long age of life on earth). So it becomes incumbent on us to examine the reliability of these physical and chemical dating methods. We may wish to avoid getting into nitpicking details, but if we are to be honest and careful we really have little choice.

There are several books on dating methods. Perhaps one of the better ones for an initial survey is *Absolute Dating Methods* by Mebus A. Geyh and Helmut Schleicher.[5] This book lists 76 physical and chemical methods used to date the earth, the moon, meteorites, or fragments thereof. The list at first seems overwhelming. But we are not looking for pat answers. And so perhaps the best way to begin is at the beginning. Potassium/argon dating is listed first, and is often considered the most reliable dating method demonstrating a long chronology, so we will begin there.

Potassium/argon dating

Potassium/argon dating is one kind of radiometric dating (dating using radioactive material). Radioactive materials, like the starting materials of many other physical and chemical processes, transform in proportion to time and the amount present at the beginning.[6]

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[5]Berlin: Springer-Verlag, 1990, hereinafter cited as Geyh and Schleicher. This book has an excellent bibliography in the back.

[6]Some readers may find this introductory discussion unnecessary. Others, however, will find it too brief. Those who do may consult standard physics,

If you start with an amount, say 10 kilograms or 22 pounds, of an unstable substance (we will call it substance A), at the end of a specified time, say 1 year, you would have only part of it left, for example 8 kilograms. In this case, if you started out with 5 kilograms instead of 10, you would have 4 kilograms at the end of 1 year. The general formula would be $A_{1\ year} = A_{Beginning} \times 0.8$, for 1 year's wait (In line with conventional usage we will use A_0 for $A_{Beginning}$). But if you started with 10 kilograms and waited 2 years, you would not have 6 kilograms. At the end of the first year you would have 8 kilograms. This 8 kilograms becomes your starting point for the second year, and the amount at the end of the second year is 8 x 0.8, or 6.4 kilograms. By the same token at the end of 1/2 year, the amount will not be 9 kilograms but slightly less than 9 kilograms. This makes the formula $A_{1\ year} = A_0 \times 0.8$ awkward to use.

A more convenient set of formulas are $\ln (A_0/A) = kt$ and (essentially the same formula) $A = A_0\, e^{-kt}$. (For those whose eyes glaze over at the mere mention of calculus, it may be of some help to note that only standard formulas are used in this text. These formulas are included for the benefit of readers who want to go into the subject more thoroughly).[7]

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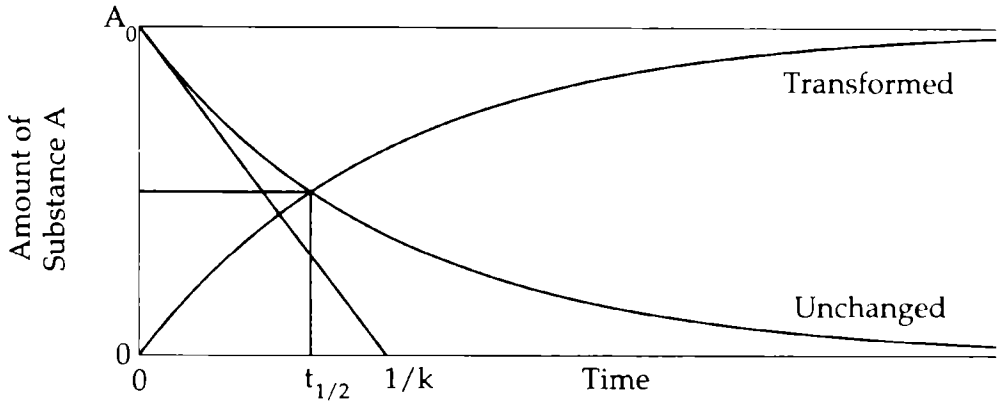
chemistry, and calculus texts and/or the introduction to a geochronology text. Two good geochronology texts are Dalrymple GB, Lanphere MA: *Potassium-Argon Dating. Principles, Techniques, and Applications to Geochronology.* San Francisco: W. H. Freeman, 1969, hereinafter cited as Dalrymple and Lanphere, and Faure G: *Principles of Isotope Geology* (2nd ed). New York: John Wiley and Sons, 1986, hereinafter cited as Faure.

[7]These formulas can be derived by using a very small time interval (theoretically infinitely small) dt and writing $-dA/dt = kxA$ or kA. That is, the amount lost in a very small amount of time (therefore the minus sign) is directly proportional to (= a constant k times) the amount at that time (in our original example k would be 0.22314/year. This means that during a very small amount of time, say 1/100,000 of a year or 5.259 minutes, our 10 kilograms would lose 0.000022314 kilograms). This can be rewritten $dA/A = -kdt$. This formula can be integrated to yield $\log_e A - \log_e A_0 = -k(t - t_0) = -kt$ (we will define $t_0 = 0$), or $\ln (A_0/A) = kt$ (t is now the time from the beginning of the period). Taking the exponential of both sides we have $A_0/A = e^{kt}$ or $A/A_0 = e^{-kt}$ or $A = A_0\, e^{-kt}$. Many texts use the Greek letter λ instead of k for the time constant. Most readers are acquainted with logarithms to base 10. Some may not be familiar with logarithms to base *e*. Logarithms to base *e*

($e = 1 + 1/1 + 1/[1x2] + 1/[1x2x3] + 1/[1x2x3x4] + \ldots = 2.718281\ldots$) are slightly more difficult for common usage, but the natural result of calculus (thus the name natural logarithm and the abbreviation ln), simpler theoretically, and much easier for computers. We may compute

We will see these formulas and variants again and again. They can be graphically represented by the following:



Note that the inverse of the constant k gives the time at which all of the substance would have transformed if it had kept up its initial rate of transformation. This is sometimes called the mean life. There is another constant, the half life (or $t_{1/2}$), which is the time at which half of the material is gone. It is equal to ln 2 (= 0.693147 . . .) times 1/k. Also note that the amount of material transformed at a given time (the daughter product D) can be found by the formula $D = A_0 (1 - e^{-kt})$. If one knows the starting amount A_0 one can find the time needed to leave only a given amount of unchanged A by the formula $t = (\ln [A_0/A])/k$. If A_0 is not known one can calculate it by the formula $A_0 = A + D$. But this is only valid if there was no D present at the beginning and there has been no D or A gained or lost since the beginning (other than by spontaneous transformation of A to D). If there has been D present at the beginning (D_0), or if D has been added (D_A) or lost (D_L) since the beginning, then the formula for finding the D formed from A, D*, is $D^* = D - D_0 - D_A + D_L$, and $A_0 = A + D^*$. If there has been gain or loss of A (other than spontaneous transformation) since the beginning, there is no easy universal formula for correcting the time estimate for such gains or losses. We shall find these conditions particularly important.

$e^x = 1 + x/1 = x^2/[1x2] + x^3/[1x2x3] + x^4/[1x2x3x4] + \ldots$.

If $0 < x < 2$ we may compute $\ln x (= \log_e x) = (x-1) - (x-1)^2/2 + (x-1)^3/3 - (x-1)^4/4 + \ldots$, whereas if $x > 1$ we may find ln x by using $\ln x = -\ln (1/x)$. There is no such simple formula for $\log_{10} x$ or 10^x. The two systems are related by the formulas $\log_{10} x = \ln (x) / \ln (10)$ and $10^x = e^{x \ln 10}$.

We will now review the theory behind radioactivity. Atoms are nearly digital entities. That is, each atom has a whole number of protons, neutrons, and electrons, and its weight (or more properly, mass) is equal to their combined masses minus a very small mass called the binding energy. An electron has very small mass compared to a proton or a neutron (which have roughly equal mass), and for most purposes its mass can be ignored. This means that the mass of each atom is a nearly perfect function of the number of protons and neutrons in its nucleus. The number of protons in an atom determines the number of electrons it has when electrically neutral, and thus almost all of its chemical properties. All atoms of a particular element have the same number of protons. Thus even though technically it would be proper to write $_1$H for hydrogen and $_2$He for helium, the abbreviations H and He already contain the information in the subscript and it is not necessary to do so. However, the number of neutrons in hydrogen is not specified by the symbol H, and so to distinguish the different kinds of hydrogen we write their digital mass (protons + neutrons, = nucleons) either in the upper left or the upper right corner. Thus deuterium, hydrogen with one neutron and one proton (two nucleons), is written ^{2}H or H^2 (the former is more common). Hydrogen without any neutrons is written ^{1}H, and hydrogen with two neutrons (tritium) is ^{3}H.

Some isotopes are unstable and spontaneously break down, or transform, into other elements. Thus ^{3}H will eject an electron and turn into ^{3}He (with two protons and a neutron). This transformation process is called radioactivity. There are 4 different major (for our purposes) kinds of radioactivity. First, a nucleus can eject an alpha particle, or ^{4}He nucleus and thus lose 2 neutrons and 2 protons. This happens mainly with nuclei that are too big to be stable. Second, it can eject an electron, as ^{3}H does, and turn a neutron into a proton. This happens mainly with nuclei that have too high a proportion of neutrons. Third, it can eject a positron (a positive electron) which then annihilates an electron, sending 2 gamma rays (an electromagnetic radiation, related to light but more energetic than x-rays) in opposite directions. In what gives the same final result, except for a different kind and amount of gamma rays (or x-rays), it can capture one of the electrons orbiting it. This is called K-capture. Both of these processes turn a proton into a neutron, and happen to nuclei which have too high a proportion of protons. Fourth, certain nuclei which

are too heavy will spontaneously split into 2 comparable (usually not equal) halves, along with usually a few leftover neutrons. This is called fission. (In addition, a nucleus can be made in an excited state which emits a gamma ray, or in some cases gamma rays, and thereby loses a very small amount of mass. This does not affect the number of protons or neutrons and so will not be further considered here.) In all these cases the mass of the end products is slightly less than that of the starting material. The excess energy is transformed either into gamma rays or into motion of the end products. For example, ^{3}H weighs slightly more than ^{3}He.

What governs which atoms are stable and which are unstable (and how unstable they are) is not completely understood, and the part that is understood is complicated to explain. Perhaps the only additional observation we should make here is that nuclei seem to prefer to have an even number of protons and an even number of neutrons. Thus potassium-40, or ^{40}K,[8] is unstable, even though it has a good balance of neutrons (21) and protons (19), because there are odd numbers of both. It will decay to either ^{40}Ca (calcium) or ^{40}Ar (argon).

One of the unusual things about radioactivity is that except for K-capture, which is very slightly influenced by the chemical enviornment and pressure,[9] the rate of decay (the constant k) is not measurably influenced by any known enviornmental factor. Neither temperature, electric or magnetic field strength, light, x-rays, nor any other variable is known to influence the rate of decay. This makes radioactive decay the best physical or chemical method of measuring time.

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[8]The abbreviation is for Kalium.

[9]Apparently because pressure creates a higher density of electrons, particularly K-electrons, near (actually in) the nucleus. The deviation in the half-life is 0.6% for ^{7}Be at 270 kbar (Hensley WK, Bassett WA, Huizenga JR: "Pressure dependence of the radioactive decay constant of beryllium-7." *Science* 1973;181:1164-5). This is far too small to account for the discrepancy between the time frames under discussion. A change in chemical enviornment makes an even smaller difference in the half-life (<0.2% in the case of beryllium-7, the most highly influenced isotope). There are theoretical reasons for expecting a slight effect of chemical enviornment on other isotopes, but the expected effect is so small that if it exists we are unable to measure it. See Dalrymple GB: *The Age of the Earth*. Stanford: Stanford University Press, 1991, pp. 86-90 for a good summary of the available experimental evidence and theory.

Potassium has at present a uniform mixture of ^{39}K (93.2581%) and ^{41}K (6.7032%), both of which are stable, and ^{40}K (0.01167%). This ratio has been the same wherever it has been measured. As noted before, ^{40}K is radioactive. Its decay constant is 5.543×10^{-10}/year, which corresponds to a half life of 1.250×10^9 years. It decays to either ^{40}Ca (88.8%) via beta decay, or to ^{40}Ar (11.2%).[10] The ratio of production of ^{40}Ar to ^{40}Ca is called the branching ratio. The radiogenic ^{40}Ca is hard to distinguish from ^{40}Ca already in the enviornment (The distinction can sometimes be made. We will come to that later). But radiogenic ^{40}Ar can be distinguished from atmospheric argon (about 1% of air is argon) by the presence of ^{36}Ar (0.337%) and ^{38}Ar (0.063%) in atmospheric argon (which leaves ^{40}Ar at 99.600% and a $^{40}Ar/^{36}Ar$ ratio of 295.5 to 1). This makes it possible to devise a dating method which is valid if the following assumptions are satisfied:

1. The rate of decay, and the branching ratio, of ^{40}K have not changed.
2. The material in question lost all its argon at an identifiable time t_0.
3. No argon has been lost since time t_0.
4. No argon except atmospheric argon, with today's $^{40}Ar/^{36}Ar$ ratio, has been gained since time t_0.
5. No potassium has been gained or lost since time t_0, except by decay.
6. The ratio of ^{40}K to total K is constant.
7. The total K, ^{40}Ar, and ^{36}Ar in the material in question can all be measured accurately.

For situations in which these assumptions are satisfied, we may derive a standard formula for potassium/argon dating:

$$t = \ln (^{40}K_0/^{40}K) / k \qquad \text{(Assumptions 1a,5)}$$
$$= \ln [(^{40}K + ^{40}Ar^* + ^{40}Ca^*) / ^{40}K] / k \qquad \text{(Decay products)}$$
$$= \ln [1 + (^{40}Ar^* + ^{40}Ca^*) / ^{40}K] / k \qquad \text{(Algebra)}$$
$$= \ln [1 + (^{40}Ar^* / 0.112) / ^{40}K] / k \qquad \text{(Assumption 1b)}$$
$$= \ln [1 + ([^{40}Ar - (^{36}Ar \times 295.5)] / [0.112 \times ^{40}K])] / k$$
(Assumptions 2,3,4) (Assumptions 1a,6)

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[10]Via K-electron capture with a gamma ray (11.0%), K-capture without a gamma ray (0.16%), or positron emission (0.001%). The mechanism does not really matter for our purposes.

$$t = \frac{\ln (1 + [^{40}Ar(^{36}Ar \times 295.5))}{(0.112 \times K \times 0.0001167) \times 5.543 \times 10^{-10}} \text{ years}$$

(Assumptions 1a,6)

According to assumption 7 we can measure total K, ^{40}Ar, and ^{36}Ar. This formula uses units of moles per gram of sample. A slight correction is necessary if units of weight (mass) are to be used.

Potassium/argon dating has been used extensively, so there is a large amount of evidence regarding its fit with evolutionary[11] theory. It actually fits fairly well. Some studies give the impression that it fits perfectly, but such studies often use filtered data (that is, the data that fit best).[12] The boundaries of the geological time periods have been moved to fit potassium/argon dating.[13] And many minerals are not felt to be suitable for analysis; they do not give the expected dates. For these reasons the fit is not quite as good as might be thought. However, for

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[11]We will use the term evolution, rather than theistic evolution. This is for brevity, to avoid awkward phrases, and because the time scale is common to all theories of evolution. We will also use the term creationist instead of special creationist for brevity and to avoid awkward phrases, even though theistic evolutionists are technically creationists.

[12]For example, Evernden JF, Savage DE, Curtis GH, James GT: "Potassium-argon dating and the Cenozoic mammalian chronology of North America." *Am J Sci* 1964;22:145-98. For evidence of their selectivity, see their discussion on pp. 171-4 of why all but one potassium/argon date for the Rusinga Island biotites was discarded. Then note their continued apparently uncritical use of biotite in other areas where the dates obtained matched their expectations. Note also that "Unfortunately many of the samples that passed field inspection for suitability and were laboriously collected, later proved unsuitable for dating. . . . Thus, of some 65 samples collected by M. Skinner, only 10 could be used." (p. 174) It might have been interesting to know why such samples proved unsuitable for dating, and what their potassium/argon dates were.

It is interesting to speculate what would happen if an article in chemistry or medicine were submitted with perhaps 1/6 of the data reported. It is difficult for me to believe that the article in question would have become a classic, as the article by Evernden *et al.* apparently has.

In point of fact, the selectivity in this article may be even greater than noted above. Sometimes the whole rock basalt date is reported, and sometimes a mineral fraction from the basalt is dated instead, such as biotite or sanidine. Why one type of date is used at one time and not at another is not specified. If there are 3 mineral fractions per basalt sample, there are 4 different possible dates for that sample. Thus one could pick the dates that fit one's expectations and create a very impressive list of dates with close agreement without there being more than a general correlation of most dates with one's expectations.

[13]See Geyh and Schleicher, p. 374 chart.

certain minerals the fit is quite good. Any creationist explanation of potassium/argon dating must account for its relatively good accord with the evolutionary time frame.

From an evolutionary perspective biotite and hornblende give the best dates. Dates on hornblende are most often in accord with the evolutionary time scale, but biotite is more widespread and retains its potassium/argon age under fairly severe weathering conditions. Many other minerals such as sanidine, anorthoclase, plagioclase, leucite, nepheline, muscovite, phlogopite, and lepidolite (all igneous and/or metamorphic minerals) can be dated by the potassium/argon method. Whole rock basalt (lava) can also be used. Only one sedimentary rock, glauconite, can be dated by this method and the results are not always considered to be reliable. Several sedimentary rocks which contain large amounts of potassium, particularly sylvite (KCl), which is over 50% potassium by weight, are not considered satisfactory.

The extensive use of potassium/argon dating also provides a fair amount of evidence bearing on the underlying assumptions. We should turn our attention to those assumptions now. In doing so, we should keep in mind several considerations. First, when we read any statement, we should ask, "How does the author know?" Statements without adequate evidence should not be determinative in our inquiry.[14] There is a place for a certain kind of scientific skepticism. Second, we should not assume the evolutionary time scale when evaluating potassium/argon dating. Since the explicit purpose of our inquiry is to evaluate whether potassium/argon dating supports the evolutionary time scale, it would be circular reasoning to assume the evolutionary time scale at the outset of our inquiry. On the other hand, we will not assume a creationist time scale either (However, we may use evolutionist or creationist assumptions as limiting cases). Finally, we cannot use another dating method to calibrate potassium/argon dating until we have examined the other method and established

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[14]This does not mean that all statements are presumed false until proven true. Statements whose basis can reasonably be believed to be experimental have some weight. Statements which are based on theory which is not being challenged have some weight. But statements which depend on the theories which are being evaluated cannot themselves support those same theories. That would be circular reasoning. These statements can only be used to help determine the internal consistency of a theory, or to suggest plausibility to the one who made the statement.

its validity. At present we have not done so for any radiometric dating methods. For now, correlations with other methods will not be used unless both evolutionists and creationists agree on their validity.

We now turn our attention to the underlying assumptions. The last assumption, number 7, is one of the safest. Measurements of potassium that have been made in different laboratories, and with different methods, are repeatedly in agreement to within experimental error. The isotope dilution method of measuring argon has a firm theoretical basis, and in appropriate specimens it yields results which match those obtained from volumetric and neutron activation analyses. The limitations in the accuracy of the various methods of measurement are fairly well-understood. We can accept the the "raw" data as basically accurate.

Assumption 6 is similarly secure. The isotopic composition of potassium from many sources has been measured, and the results are always essentially the same. Natural isotopic enrichment effects can be safely ignored.

Assumption 5 is fairly safe. In most situations where potassium has been either gained or lost from a mineral, the mineral has been noticeably altered (it would be difficult to do this without affecting the argon to an even greater extent). Replacement of the potassium in a rock with potassium from other sources, so long as the isotopic concentration is not significantly altered, would have no effect on the apparent age derived by the above formula. And if there were a problem of this nature, to effect the changes needed to explain the time difference between evolutionary and creationist models (up to 5 orders of magnitude), a creationist would need up to 5 orders of magnitude increase in the initial potassium content of our specimens, a physical impossibility (it would require more than 100% potassium). Nor can isotopic enrichment and then depletion effects bridge this gap in any reasonable manner.

Assumption 4 is probably satisfied for most samples. It would only be incorrect for materials which are heated in the presence of argon from the earth's mantle, which apparently contains almost entirely ^{40}Ar, or perhaps in primordial argon, which may have had a higher concentration of ^{36}Ar than the present atmosphere. We will tentatively accept it, keeping in mind that it may be challenged.

Assumption 3 is fairly commonly violated, according to most texts on potassium/argon dating. That is, according to the standard interpretation of potassium/argon dating, many rocks lose argon. Specifically, most sedimentary rocks are supposed to lose argon because their crystal structure cannot retain it. Glauconites appear to be the only sedimentary minerals from which an appropriate age (from the evolutionary perspective) can (sometimes) be obtained. Certain minerals such as sylvite appear to lose argon in recrystallization (or perhaps cannot retain argon); at least their ages are consistently much too young for the evolutionary time scale. Rocks that have been heated after formation can be demonstrated to have younger potassium/argon ages than similar rocks from the same formation which have not been heated. Several processes are listed in standard texts as explanations for this argon loss, such as metamorphism, weathering, and reheating. We will return to this assumption later. We will only note for now that the violation of this assumption would cause the rock to date younger than its age of formation. Depending on the loss of argon, this date could be as low as recent (< 5000 years).

Assumption 1 is often challenged by some creationists. They reason that radioactivity could have speeded up during the Flood, possibly providing a contributory cause of the Flood, and producing erroneously high apparent ages. For every order of magnitude that one increases the decay rate, one increases the apparent age of the rock by the same order of magnitude. The relationship is mathematically perfect. The only way to tell that anything unusual took place is to note whether daughter products have escaped as expected. There is some evidence which can be interpreted as a disequilibrium of helium and of argon.

The major problem with this creationist view is the absence of a mechanism to explain or predict the change in the half life. Theoretically radioactive decay could be caused by some mechanism such as neutrinos, rather than being random from the point of view of the atom, but no evidence of a decrease in any half life has been noted during recent supernova explosions, for instance.[15]

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[15]A minor problem is determining which radioactive decay processes are affected. Presumably it would have to be all of them, or all of one kind, or one particular isotope, or else this creationist hypothesis is just another *ad hoc* hypothesis.

A systematic change in radioactive time constants is still a theoretical possibility, but until there is direct evidence for it we will use it as a last resort, only if radiometric dating is otherwise secure, but compelling non-radiometric evidence requires a short span for the history of life on this earth.

Assumption 2 sounds logical at first, and is usually stated in texts as self-evident.[16] But it is one of the few testable assumptions (along with assumption 6 and 7), and so it should be checked.

I am aware of very few direct experiments in which rocks are heated to see if the argon is all driven off under realistic geologic conditions to reset the potassium/argon clock. Of course, rocks are heated routinely in a vacuum to drive off their argon for measurement. But no one would argue that the rocks in an igneous intrusion, for example, were intruded under vacuum conditions.

In one experiment, muscovite was heated to 740° to 860° C under high argon pressures (2,800 to 5,000 atmospheres) for periods of 3 to 10.5 hours. The muscovite absorbed significant quantities of argon (producing potassium/argon ages of up to 5 billion years), and the absorbed argon appeared like ordinary "radiogenic" argon.[17] In another experiment, muscovite was synthesized from a colloidal gel under similar argon pressures and temperatures. The muscovite synthesized in this way contained up to 0.5% argon by weight![18] These experiments show that under

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[16]For example, Geyh and Schleicher, p. 56: "What is special about the K-Ar method is that the daughter nuclide is a noble gas, which is normally not incorporated into minerals and is not bound in the mineral in which it is found." Dalrymple and Lanphere state on p. 46: ". . . a silicate melt will not usually retain the ^{40}Ar that is produced, and thus the potassium-argon clock is not "set" until the mineral solidifies and cools sufficiently to allow the ^{40}Ar to accumulate in the mineral lattice." Dalrymple (see note 9) states on p. 91, "The K-Ar method is the only decay scheme that can be used with little or no concern for the initial presence of the daughter isotope. This is because ^{40}Ar is an inert gas that does not combine chemically with any other element and so escapes easily from rocks when they are heated. Thus, while a rock is molten the ^{40}Ar formed by the decay of ^{40}K escapes from the liquid."

[17]Karpinskaya TB, Ostrovskiy IA, Shanin LL: "Synthetic introduction of argon into mica at high pressures and temperatures." *Isv Akad Nauk S. S. S. R. Geol Ser* 1961;8:87-9.

[18]Karpinskaya TB: Synthesis of argon muscovite." *Internat Geol Rev* 1967;9:1493-5. This is approximately 2,500 times as much argon as is naturally found in the usual muscovite, and it is mostly liberated again at over 300° C. A linear interpolation would seem to indicate that the usual potassium/argon dates could be obtained with ^{40}Ar partial pressures of as little as 2 atmospheres.

certain conditions argon can be incorporated into rocks that we are told are supposed to exclude argon when they crystallize. This makes me uncomfortable accepting assumption 2 without further evidence. One might even argue that minerals should not lose argon without someplace for it to go. But such conditions are not likely to be realistic geologic conditions either.

Perhaps the best way to test assumption 2 is to find formations that everyone can agree were formed within the last 5 to 10 thousand years, date them, and see if they date to essentially zero. This has been done by Dalrymple.[19] He dated several lava flows which are known to have erupted in modern times. Most of the lava flows had essentially zero potassium/argon ages. However, about 1/5 of the flows had excess ages. The flows that dated oldest all had ultramafic xenoliths and xenocrysts (small rocks and crystals of foreign material) mixed into the lava. The excess argon, and the extra apparent age, was attributed to these foreign materials, which themselves could date over 1 billion years old.[20] Doubt was also expressed about the resetting of phenocrysts (crystals which apparently crystallized from the lava itself), although all the lavas dated had phenocrysts, and some phenocrysts had only argon whose isotopic composition matched that of air.[21] From this Dalrymple concluded that basalt can have its

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I have found one reference on the introduction of argon into glass, Roy DM, Faile SP, Tuttle OF: "Effect of large concentrations of dissolved gas on properties of glasses." *Phys and Chem of Glasses* 1964;5:176-7. The argon introduced (under 1/2 to 10 kbar) was not quantified, but was noted to be dissolved rather than in bubbles.

The alert reader may wonder why I have not cited data for biotite or hornblende. The reason is because I am not aware of any such data. All the experiments on potassium-bearing minerals I have found in the literature are cited in this and the previous note.

[19]Dalrymple GB: "$^{40}Ar/^{36}Ar$ analysis of historic lava flows." *Earth Planet Sci Lett* 1969;6:47-55.

[20]Dalrymple, see note 19, citing Funkhouser JG: "The determination of a series of ages of a Hawaiian volcano by the potassium-argon method". Univ of Hawaii Ph.D. thesis, 1966. Dalrymple's citation is accurate. For those who are going into the subject in depth I recommend the thesis.

[21]A plagioclase phenocryst from Surtsey that was 1 cm in diameter gave an $^{40}Ar/^{36}Ar$ ratio of 298.9, which was not statistically different from the value of 296.1 which Dalrymple' mass spectrometer gave for air. However, the Mt. Etna 1792 basalt and the Mt. Lassen plagioclase both dated high, and both had large phenocrysts but no xenocrysts. In addition, Dalrymple cited the work of Damon *et al.* (Damon PE, Laughlin AW, Percious JK: "Problem of excess argon-

potassium/argon clock reset, but this is reliable only if there are no xenocrysts or xenoliths in the basalt. The xenocrysts apparently can retain most of their argon even when heated to the temperature of molten lava. Furthermore, tests on basalt which flowed into the ocean showed that although the lava which hardened above the water dated to essentially zero age, basalt which cooled under the water could date as high as 43 million years old.[22] This would of course be relevant for a creationist who believes that the world was covered with water, ocean water to be specific, during much of the Flood. Certainly if one is to avoid obviously erroneous dates in basalt, one will avoid pillow lava.

But there was another phenomenon which was noted in Dalrymple's article. Some modern lavas had $^{40}Ar/^{36}Ar$ ratios of less than 295.5. According to a straightforward interpretation of potassium/argon dating, this should be impossible. Dalrymple was not willing to write these ratios off to experimental error. Thus the straightforward interpretation has to at least be modified.

Dalrymple suggested two possible explanations for the excess ^{36}Ar (He rejected the possibility of significant ^{36}Ar formation *in situ* from nuclear reactions). The kinder one (from an evolutionary point of view) was that when argon from the air diffused back into the lava,[23] ^{36}Ar diffused in preferentially. But this would mean that the "zero age" lavas actually had an apparent age, and that most lavas do not degas upon eruption. In fact, depending on how strong is the preference for ^{36}Ar diffusion, it could even be that all lavas do not completely degas.

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40 in volcanic rocks." In: *Radioactive dating methods and Low-level counting,* Vienna: IAEA, 1967, pp. 463-481). Damon *et al.* cited several instances of phenocrysts with potassium/argon ages of 1 to 7 million years over that of the whole rock, and one potassium/argon date on olivine phenocrysts of greater than 110 million years in a recent (<13,000 year old) basalt. They also state that "Coarse [phenocryst] minerals (x > 1mm) may take more than 100 years to completely degas at lava temperatures." (p. 478) Unfortunately, they do not give the evidence for this statement.

[22]Dalrymple GB, Moore JG: "Argon 40: Excess in submarine pillow basalts from Kilauea Volcano, Hawaii." *Science* 1968;161:1132-5. These basalts were 60-90% glass, with phenocrysts. See also Noble CS, Naughton JJ: "Deep-ocean basalts: Inert gas content and uncertainties in age dating." *Science* 1968;162:265-7, where the basalts dated up to 21 million years old, and also retained helium.

[23]There was 1.7-123 million years' worth of ^{40}Ar found in the lava if one ignores the ^{36}Ar.

His other explanation was that the lavas with the anomalously high ^{36}Ar actually came from an area of the mantle that had primordial argon which had not been diluted with radiogenic ^{40}Ar, and had not completely degassed. But this means that there is no reason to assume that lava whose argon matches that of the air has degassed either. It may have simply started with argon which matched air argon.

Thus the evidence is that lava does not completely degas on eruption. The precise amount of gas lost cannot be easily quantified using the data we have on hand. It would be very helpful to expose hot lava with a known argon content to ^{38}Ar or ^{39}Ar to see how much argon actually is lost and/or gained and how fast, and what its isotopic composition is.

When we turn to how basalt is dated in the geologic column, we find statements like "basaltic glass, in contrast to acid glass, has a very poor argon retentivity and is unsuitable for K/Ar dating."[24] Mankinen and Dalrymple[25] noted that two basalts containing glass dated much younger than expected whereas the phenocrysts in one of those basalts gave the expected dates. They concluded that basalts containing glass should be rejected and in the latter case accepted the phenocryst age. This would seem to indicate that the workers in the field trust old samples that they would be reluctant to trust if they were recent, and vice versa. This is particularly striking in view of the experimental evidence that argon diffusion in glass is negligible under ordinary geological conditions.[26]

It would seem that at least the data tends to undermine the validity of the potassium/argon dating of basalt. It could even suggest that the conventional time scale is incorrect. Perhaps these basaltic glasses don't lose argon. Perhaps they simply were

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[24]Geyh and Schleicher, p. 61.

[25]Mankinen EA, Dalrymple GB: "Electron microprobe evaluation of terrestial basalts for whole-rock K-Ar dating." *Earth Planet Sci Lett* 1972;17:89-94. In one case the glass in question was unaltered, and still gave a potassium/argon age of 1.6 million years rather than 7.4 million years. These are still not creationist dates, but if lava does not routinely degas, they are easily explainable from a creationist perspective.

[26]Fechtig H, Kalbitzer S: "The diffusion of argon in potassium-bearing solids." In Schaeffer OA, Zähringer J (eds): *Potassium-Argon Dating*. New York: Springer-Verlag, 1966, pp. 68-103. It is worth quoting p. 101: "This section concludes that diffusion at room temperature is always so small that no appreciable argon losses occur."

more completely degassed at the time of the eruption and the basalt is really as young as or younger than the indicated age. Certainly no potassium/argon date for basalt should be accepted as secure until we know whether the basalt matches the characteristics of recent basalt that is consistently dated at zero by the potassium/argon method.

It might be revealing to date recent and geologically old basaltic lava, glass, phenocrysts, and xenocrysts blinded to their geological horizon, and report all the results. This is the procedure that would be done in, for example, a controversial medical research area.

(Some may object to this comparison. However, there are parallels between geology and medicine. Both are not exact sciences in the sense that physics and chemistry are. They both deal with situations with many variables, not all of which can be precisely controlled. Both have a practical aspect—finding oil, and helping patients. And both make use of multiple branches of "basic" sciences.)

Perhaps we can place greater trust in granitic intrusions. There are unfortunately no historically witnessed granitic intrusions which can be used for a baseline. So we really don't know whether or not granitic intrusions reset their potassium/argon clocks. One hint comes from a granitic xenolith from a pleistocene basalt (conventional age 60,000 years). This xenolith was estimated to have been at 1,100° C during the basaltic lava eruption, and yet its sanidine had a potassium/argon age of 2 million years (the biotite age was not given).[27] Its original "age" was estimated at 40-92 million years, so it was estimated to have retained 2-5% of its argon. Other xenoliths may have potassium/argon ages of over 1 billion years.[28] And a report from Olduvai Gorge indicates that individual biotite crystals in tuff could retain 400-800 million years' worth of ^{40}Ar.[29] Apparently the clocks in granitic xe-

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[27]Dalrymple and Lanphere, p. 143, citing Dalrymple GB: "Argon retention in a granitic xenolith from a pleistocene basalt, Sierra Nevada, California." *Nature* 1964;201:282. The granite was 10 cm in diameter and 3 m below the surface of the lava.

[28]See note 20.

[29]Walter RC, Manega PC, Hay RL, Drake RE, Curtis GH: "Laser-fusion $^{40}Ar/^{39}Ar$ dating of bed I, Olduvai Gorge, Tanzania." *Nature* 1991;354:145-9. The $^{40}Ar/^{39}Ar$ dating method is a variant of the potassium/argon dating method which uses neutron irradiation of the sample to produce ^{39}Ar from ^{39}K. Note that these results would appear to invalidate tuff dates.

noliths can be only partially reset by heating that has usually been assumed to completely reset them.

Several examples of multiple minerals including hornblende and biotite which even evolutionists admit have excess argon can be found in Dalrymple and Lanphere.[30] Another particularly obvious example is a biotite cited by Faure[31] whose potassium/argon age exceeds the traditional age of the earth!

So we can't be sure that the clock is fully reset for biotite or other granitic minerals either, and the evidence that does not depend on evolutionary presuppositions is in favor of it not being reset.

Is there a mineral that someone who does not start with evolutionary presuppositions might believe to be completely reset at the time of formation? Yes, there is. Potassium minerals in evaporite deposits should have equilibrated their argon with the atmosphere when they crystallized. One would expect that any argon incorporated into the mineral should have the same isotopic composition as that in air. Sylvite in particular is over 50% potassium by weight, which would make the potassium and argon easier than usual to measure, and can form crystals up to an inch across or larger, which would seem to make it a good candidate for argon retention.

But evolutionists do not use sylvite and similar evaporites, because of the "poor retentivity" of salt minerals, and because they recrystallize below 100° C.[32] How do we know this? Is it because someone has measured the diffusion of argon in sylvite? Or has someone tried to mildly heat or deform the crystals to see if the argon is released? Has someone irradiated sylvite with neutrons to see if ^{39}Ar will diffuse out of the crystal? No, experimental evidence is not the basis for these assertions about retentivity and recrystallization. In fact, the experimental evidence is actually against these assertions.[33] The reason these assertions

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[30]Pp. 121-144, especially pp. 126-8 table.

[31]P. 105, citing Ashkinadze GS, Gorokhovskiy BM, Shukolyakov YA: "$^{40}Ar/^{39}Ar$ dating of biotite containing excess ^{40}Ar" *Geochem Int* 1977;14(3):172-6.

[32]Geyh and Schleicher, pp. 61-2. The difficulty with sylvite has been noted since the very first use of potassium/argon dating. See Aldrich LT, Nier AO: "Argon-40 in potassium minerals." *Phys Rev* 1948;74:876-7.

[33]The diffusion of argon from sylvite has actually been measured by some of these methods, and it has turned out to be negligible under geological conditions. See Fechtig and Kalbitzer, note 26.

are made is because sylvite crystals in particular, and evaporite salts in general, give potassium/argon dates much younger than their evolutionary ages, so they must have lost argon somehow. That is a logical deduction as long as one knows that the evolutionary time scale is largely correct. However, if one is not irreversibly wedded to that time scale, another explanation presents itself. Perhaps the minerals are not really that old. Perhaps there is something wrong with the evolutionary time scale.

And on second thought, the theory that argon diffuses out of sylvite crystals seems contrived. If argon does not diffuse out of biotite, with its loose cleavage planes, why should argon diffuse out of sylvite, which has a close-packed crystal structure? It is of interest that several other minerals "lose argon", and yet we are told that in another mineral (this time igneous), sanidine, "diffusion of argon is several orders of magnitude faster at low temperatures than extrapolation from high temperature data would indicate."[34] And we read that

> Initially, it was hoped that these experiments [determining argon diffusion characteristics of minerals] would lead to a classification of these minerals according to their ability to retain argon. In addition, it was thought that experimentally determined diffusion coefficients might provide a way to correct "apparent" ages for argon loss and to provide a basis for using argon loss to determine the exact geologic conditions (heating, burial, and so forth) that caused the loss. Unfortunately, these goals have not been reached. Although the relative ability of most common minerals to retain argon is known, this knowledge has come largely from geologic studies rather than from diffusion experiments.[35]

In other words, the experimental evidence is against the diffusion which must have happened if the evolutionary time scale is correct, and so the standard approach has been to ignore the experimental evidence and try to create a scenario compatible with the evolutionary time scale. Now that is fine if you know

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[34]Geyh and Schleicher, p. 62, citing Marshall BD, Woodard HH, DePaolo DJ: "K-Ca-Ar systematics of authigenic sanidine from Waukau, Wisconsin, and the diffusivity of argon." *Geology* 1986;14:936-8. The potassium/argon age in this paper was up to 75 million years less than the stratigraphic age (>454 million years).

[35]Dalrymple and Lanphere, p.151.

that the evolutionary time scale is correct. But if we are trying to make an unbiased effort to determine the validity of the evolutionary time scale, the evidence does not appear to support that scale.

I have seen no independent evidence to support the suggestion that mild heating accounts for low potassium/argon dates in sylvite. The best evolutionary theory to explain the evaporite data would seem to be that which has also been advanced to explain the "anomalously" young $^{87}Rb/^{87}Sr$ and $^{40}K/^{40}Ca$ ages of the same minerals. The sylvite periodically re-dissolves in water. This does not seem unreasonable. It might be interesting to re-examine these deposits to see whether there is other evidence for recrystallization that would support this repeated solution theory.

From a creationist standpoint the evaporite deposits still present a problem. For if they are truly simple evaporite deposits, the potassium/argon dates would be predicted to be zero, and yet Devonian sylvite deposits (conventionally dated ca. 350 million years old) have potassium/argon dates of around 200 million years. So the question remains, why don't the deposits date at zero?

I can think of two possible explanations which would allow a creationist time frame. First, it is possible that sylvite absorbs argon underground, either directly or as a result of recrystallization. It is of interest that if there is recrystallization, buried sylvite and carnallite can apparently incorporate argon, and radiogenic argon at that, on recrystallization.[36] It would be interesting to

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[36]This is because rubidium/strontium and potassium/calcium dates give a maximum age of 2-100 million years for (Permian) sylvite that dates 200 million years old by the potassium/argon method (Baadsgaard H: "Rb-Sr and K-Ca isotope systematics in minerals from potassium horizonsin the Prairie Evaporite Formation, Saskatchewan, Canada." *Chem Geol (Isot Geosci Sect)* 1987;66:1-15). Thus even by evolutionary criteria this sylvite occluded over 100 million years' worth of argon on (re?)crystallization.

Incidentally, this discussion illustrates one of the problems in comparing two general scientific theories (or research programs, as Lakatos would call them). There is often no single piece of evidence that conclusively proves one theory superior to the other. The judgment more often has to be made on the basis of which theory fits the relevant facts best, and that depends on which facts are considered most important and well-established, and how hard we search for facts and theoretical predictions. In this case should we close our investigation on hearing that published potassium-argon dates often match the evolutionary time scale, or on hearing that sylvite dates too low for the evolutionary time scale, or on hearing that sylvite dates do not neatly fit a creation-

crystallize evaporites under high argon pressures to see how much argon is actually incorporated.

Second, these deposits may not be evaporite deposits at all. It has been strongly (and persuasively) argued[37] that whatever else they are, they are not seawater evaporites. The puzzle of their formation has not been solved, and it would seem premature to use them as proof of an old earth until their formation is better understood, although they may be given due weight.

One final point deserves consideration. It is still proper for an evolutionist to point out that potassium/argon dating as currently used matches the evolutionary time scale. A creationist explanation of potassium/argon dating must state not only why the current usage is incorrect but also why the dates at present line up with the evolutionary time scale as well as they do. A start can be made by noting that many dates do not fit, as noted above, and that there is some selectivity in the kinds of samples and specific samples that are dated.[38] There is also selectivity in which samples are submitted for publication (no one likes to submit ambiguous or chaotic data), and which are published (review-

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ist model, or on hearing that the rubidium-strontium dating evidence suggests the possibility of sylvite occluding argon? In theory, of course, even this is not enough. We shall have to test that possibility experimentally, and the exploration goes on forever. In practice we have to stop at least for now with the observations that have been done and make the best tentative judgment we can on the basis of the available data.

However, I do not think that the process is totally subjective. Eventually we should reach the place where one theory continually runs into problems and the other continually points to new correct observations. When this happens, we can provisionally accept the latter theory, and insist that the former explain parsimoniously the difficulties presented to it before we reconsider our judgment.

This means that we may be required to do a good deal of gruntwork in order to establish whether multiple pieces of evidence fit obviously better into one theory, or whether the evidence is truly equivocal. We may not like it, but intellectual honesty requires a fair treatment of all the evidence.

[37]Hardie LA: "The roles of rifting and hydrothermal $CaCl_2$ brines in the origin of potash evaporites: An hypothesis." *Am J Science* 1990;290:43-106. Hardie argued for most of the evaporite deposits being the result of the evaporation of $CaCl_2$ brines in rift and other extensional fault basins. He cited no modern examples of extensive KCl deposits.

[38]For example, see the recommendation to get a geochronologist to select pilot samples, which then guide the selection of final samples, in Geyh and Schleicher, p. 7.

ers do not like to approve publication of these data, and editors do not like to publish them). Incidentally, these distortions of the data are for the most part done innocently. The same thing happens, for example, in medicine. Positive results are always easier to publish than negative results, and both are easier to publish than chaotic results. However, this selectivity may be somewhat offset by a reverse selectivity which can happen in the publishing of textbooks. That is, the textbooks I have cited may collect the problem dates more than the usual ones (and most of my data is obtained from literature cited by various textbooks).[39] There is still a real order to most of the potassium/argon dates which needs explanation.

There are three explanations from a creationist perspective for a gradation of potassium/argon dates from older to younger for rocks without significant differences in real age. First, there may have been gradually decreasing argon concentrations and pressures as time during a Flood passed, perhaps because of gradual degassing of the mantle. Second, rocks later during the Flood may have formed under less (hydrostatic) pressure than those formed earlier. This would allow them to be more thoroughly degassed for the same temperature. Finally, the later rocks may have been more thoroughly melted, and for a longer time period, allowing more inherited argon to escape from the later rocks. Perhaps all three mechanisms were operative to some extent. All these explanations seem plausible, and there is evidence for the first one.[40] So it would seem that there is a creationist model which is believable, and which has supporting evidence for its explanation of the general trend of potassium/argon dates in the geological column.

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[39]That is my feeling on reading the texts cited above. However, it is not the usual case in textbooks. Most texts simplify experiments and emphasize the positive, often glossing over problems. The possibility remains that the texts I have cited are also biased in favor of the approved theories, in which case the evolutionary interpretation of potassium/argon dating is in even worse trouble than here portrayed.

[40]Beryl and cordierite contain essentially no potassium, yet "*It may be stated that the helium and argon content of beryl and cordierite increases with the age of the mineral and there is no relationship between this phenomenon and the alpha emission, potassium content, chemical composition or mineralogical environment of the mineral.*" (Damon PE, Kulp JL: "Excess helium and argon in beryl and other minerals." *Am Min* 1958;43:433-59. The quote is from p. 445, italics theirs) This is true especially of ^{40}Ar. This observation would be predicted by a creationist, but I have not seen a good explanation of this from an evolutionary standpoint.

To summarize, modern basaltic lava potassium/argon dates indicate that the current use of potassium/argon dating is probably invalid, and the glass dates at least suggest a shorter chronology. Biotite and other plutonic minerals are consistent with this position, although the supporting data there is not as complete as we would like. The data on sylvite and other evaporite minerals are problematic for both a short chronology and a long chronology, although the problems for a long chronology appear to me to be as great or greater in spite of the greater research effort to solve them from that chronology's point of view. With the data examined so far, a (special) creationist model for the age of life on the earth provides a more straightforward approach than an evolutionary one.

Other Dating Methods

If potassium/argon dating is actually slightly in favor of the creationist position, perhaps we should re-examine the other dating methods to see if they really do dovetail with evolutionary theory as well as it is claimed. So we turn again to Geyh and Schleicher and look at those 75 other methods. Some of them, such as $^{138}La/^{138}Ce$, $^{176}Lu/^{176}Ha$, and $^{207}Pb/^{206}Pb$, are used only for precambrian material, and thus are irrelevant for dating life. They may be valid, or they may be invalid, but it doesn't really matter for our purposes. Some, such as ^{3}H, ^{210}Pb, and ^{228}Th excess/^{232}Th, are used only for recent (<3000 year old) samples, and thus again irrelevant for the question at hand. Some are considered highly experimental, such as the $^{10}Be/^{36}Cl$ method (if evolutionists do not have confidence in a method or its assumptions, it would seem difficult to use it to disprove a creationist time scale). Some are essentially variations on other methods, such as the $^{39}Ar/^{40}Ar$ method.[41] Some are only relative dating methods, such as paleomagnetism and stable oxygen isotopes. Some are used on only meteorites or lunar rocks and are mostly irrelevant for dating life on the earth (all except for the terrestial ages of meteorites).

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[41]Which is a variation on $^{40}K/^{40}Ar$ dating and subject to the same criticisms. The only apparent advantage of the $^{39}Ar/^{40}Ar$ method, the plateau effect, is not always present, and it is sometimes grossly wrong by anyone's standards when it is present. See Ashkenadze *et al.* in note 31.

And some are obsolete, like the chemical lead method. Some, of course, suffer from more than one drawback for our purposes. When all these extraneous methods are removed from consideration, we are left with the following methods: $^{87}Rb/^{87}Sr$, $^{40}K/^{40}Ca$, $^{147}Sm/^{143}Nd$, uranium/thorium/lead and lead/alpha, krypton/krypton, uranium/xenon and xenon/xenon, ^{14}C, ^{36}Cl, ^{53}Mn, ^{81}Kr, ^{129}I, ^{26}Al, ^{10}Be, most of the U and Th disequilibrium series, U/He, Thermoluminscence and relatives, Fission tracks, Pleochroic haloes, terrestrial exposure ages of meteorites, Amino acid racemization, Nitrogen content of bones, and Obsidian hydration. This is still an impressive list, but a far cry from the 76 methods we started with. And this list can be whittled down still further. Three little-used methods are similar enough to $^{40}K/^{40}Ar$ dating that they are subject to the same criticisms and can be safely ignored, one is grossly inaccurate by anyone's standards, and one is a combination of other dating methods.

The krypton / krypton method utilizes the fact that ^{238}U spontaneously fissions at a very slow rate, producing krypton in some fission events. This krypton from spontaneous fission is compared to the krypton produced by the neutron-induced fission of ^{235}U, which is used in this method to measure the ^{235}U concentration. Because there is a constant ratio of ^{235}U to ^{238}U, the concentration of ^{238}U is known if the concentration of ^{235}U has been determined. The resetting of the krypton/krypton clock requires elimination of all previously accumulated or acquired krypton. Krypton is a noble gas like argon. Since krypton atoms have a larger radius than argon, they are more easily trapped by minerals, and would be less likely to be eliminated than argon. As another parallel with potassium/argon dating, we find it suggested that krypton is lost, to account for younger ages than the "real" (evolutionary) age.[42] I have been unable to find any reports of attempted krypton/krypton dating of recent (zero age) samples.[43] Krypton/krypton dating is not a significant support to an evolutionist arguing against a young earth.

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[42]For example, Geyh and Schleicher, p. 151.

[43]An additional complication is that the samples are irradiated with neutrons, and since the neutron flux (amount of neutrons of the proper energy passing through a given area) is hard to measure, sometimes the krypton ratios are compared with those of a rock of "known" age. This procedure is justified if the reference rock is dated with either the krypton/krypton method or another reliable method, but if it is dated by the potassium/argon method, our discussion above makes the date obtained worthless as evidence for the evolutionary time scale.

The uranium/xenon method and its derivative, *the xenon/xenon method*, use xenon produced by spontaneous ^{238}U fission. In the uranium/xenon method the uranium (and therefore the ^{238}U) is measured directly. In the xenon/xenon method the uranium is measured by measuring the fission products of ^{235}U, analogous to the krypton/krypton method. The clock for these methods is reset when all the xenon is driven off. Xenon is another noble gas, with atoms larger than krypton and therefore larger than argon. Again there is reference to the loss of xenon,[44] meaning ages that are too young (although not young enough for a creationist model; only 30-70% less than required by the evolutionary time scale). And again no data has been published for "zero age" samples.[45] The data from uranium/xenon and xenon/xenon dating are not a significant support for either an evolutionist or a creationist model.

The uranium/helium method depends on the fact that for each ^{238}U that decays to lead 8 ^{4}He atoms are produced. This is complicated by the fact that uranium commonly contains ^{235}U (producing 7 ^{4}He atoms), ^{234}U (a decay product of ^{238}U producing 7 ^{4}He atoms), and ^{232}Th (thorium, producing 6 ^{4}He atoms). Thus if one knows the composition and amount of uranium and thorium present at the beginning, has a closed system (no U or Th moving in or out and especially no He moving in or out), and knows the amount of ^{4}He present at the beginning, one can estimate the time. It turns out that one cannot calculate the time straightforwardly, but one can find it graphically. Again we read of the loss of helium,[46] but this time it is a little more believable because the helium atom is so small. However, with this method there is some evidence regarding whether the clock is consistently reset. The evidence is negative. Helium is found in minerals which have no uranium or thorium, and is found in recently heated lava cooled under the sea.[47] Here is another example of retention of a noble gas. It would be helpful to find minerals that are reset when formed experimentally, and are impervious to helium diffusion,

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[44]For example, Geyh and Schleicher, p. 153.

[45]For the xenon/xenon method, the same method of comparing the rock to be dated with a rock of "known" age is used as was used for the krypton/krypton method. Again this makes the method dependent not only on the hypothesis of zero xenon initially, but also on the accuracy of the date of the "known" age rock.

[46]Geyh and Schleicher, pp. 248,250.

[47]Damon and Kulp, see note 40, and Noble and Naughton, see note 22.

and use these minerals to date ancient rocks. But without such data, it is inappropriate to use uranium/helium dating in support of either time scale.

Terrestrial ages of meteorites in our age range are primarily found using ^{53}Mn, ^{36}Cl, ^{81}Kr, and ^{129}I, and possibly thermoluminescence. These ages may be considered under the respective methods and need not be considered independently.

The nitrogen or collagen content of bones is a very rough method. It has nearly 2 orders of magnitude of demonstrated spread, and is influenced by such factors as temperature, moisture, pH, and bacterial enviornment. It is not nearly reliable enough to be of much use in differentiating between evolutionary deposits and Flood deposits.

Rubidium/strontium dating. We will now discuss the first method on our revised list. The $^{87}Rb/^{87}Sr$ method is dependent on the observation that rubidium is widely distributed with potassium (which it closely resembles chemically), and that about 1/4 (27.8346%) of the rubidium is ^{87}Rb, which is radioactive and decays by electron emission to ^{87}Sr. Its decay constant is 1.42×10^{-11}/year, which corresponds to a half life of 4.88×10^{10} years. This would make an excellent dating method if all the ^{87}Sr were eliminated at time zero. Unfortunately it is not, and so instead it is assumed that at time zero all the strontium is thoroughly mixed so that the strontium isotopes are homogeneously distributed. Strontium has three other isotopes ^{84}Sr, ^{86}Sr, and ^{88}Sr, which are present in constant ratios relative to each other[48]. One can presume that initially the isotopic strontium composition was the same throughout a (presumably melted) rock. Then the rock crystallized so that the rubidium was partially separated from the strontium. If there is strontium in some mineral without rubidium, then this mineral can be used to determine the original $^{87}Sr/^{86}Sr$ ratio.[49] If this was 0.710, and a given rubidium-containing mineral had a $^{87}Sr/^{86}Sr$ ratio of 0.720, then for every 1000 atoms of ^{86}Sr, 10 atoms of ^{87}Sr would have been produced by ra-

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[48]So that $^{84}Sr/^{86}Sr = 0.056584$ and $^{86}Sr/^{88}Sr = 0.1194$, which gives percentages in usual rock of 82.52% ^{88}Sr, 7.00% ^{87}Sr, 9.86% ^{86}Sr, and 0.56% ^{84}Sr. The percentage of ^{87}Sr varies between 6.9% and 7.4%+, depending apparently on the past and/or present rubidium content of the rock.

[49]One could use the $^{87}Sr/^{88}Sr$ ratio or the $^{87}Sr/^{84}Sr$ ratio but the $^{87}Sr/^{86}Sr$ ratio is closer to 1, easier to work with, and the traditional one.

dioactivity. If in this mineral the $^{87}Rb/^{86}Sr$ ratio was 0.40, then for every 1000 atoms of ^{86}Sr there would be 400 atoms of ^{87}Rb. Thus the original ^{87}Rb concentration would have been 400 + 10, or 410 / 1000 atoms of ^{86}Sr. The formula for the age of the mineral would be $t = \ln (410/400)$ years$/(1.42 \times 10^{-11})$, or 1.74 billion years. If $^{87}Sr/^{86}Sr$ is the ratio in the rubidium-containing rock, and $(^{87}Sr/^{86}Sr)_0$ is the ratio of the rock with no rubidium and therefore the ratio at the time of homogenization, and $^{87}Rb/^{86}Sr$ is the ratio in the rubidium-containing rock, then the general formula for the age is $t = \ln ([^{87}Rb/^{86}Sr + {}^{87}Sr/^{86}Sr - (^{87}Sr/^{86}Sr)_0] / [^{87}Rb/^{86}Sr]) / k$. The problem with using this formula is that we rarely have a mineral with essentially no rubidium but enough strontium to determine the initial $^{87}Sr/^{86}Sr$ ratio. So what is usually done is to obtain several minerals with different degrees of rubidium enrichment so that they have different $^{87}Rb/^{86}Sr$ ratios. Then the $^{87}Rb/^{86}Sr$ ratios are plotted against the $^{87}Sr/^{86}Sr$ ratios. Several assumptions are made:

1. The radioactive decay constant of rubidium has been invariant.
2. The strontium isotopes were evenly distributed at time t.
3. No net rubidium migration has occurred since time t.
4. No net migration of strontium isotopes has occurred since time t.
5. We can accurately measure the $^{87}Rb/^{86}Sr$ and $^{87}Sr/^{86}Sr$ ratios in a given set of minerals.

If these assumptions are correct, we will find our plot giving a straight line:[50] $^{87}Sr/^{86}Sr = (^{87}Sr/^{86}Sr)_0 + (e^{kt} - 1)\, ^{87}Rb/^{86}Sr$. This is in the form of $y = a + bx$. The value a gives the intercept, and b gives the slope, which in this case is $(e^{kt} - 1)$. Thus picking some ideal example numbers, we might see a graph like this:

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[50]The derivation of the formula is as follows:

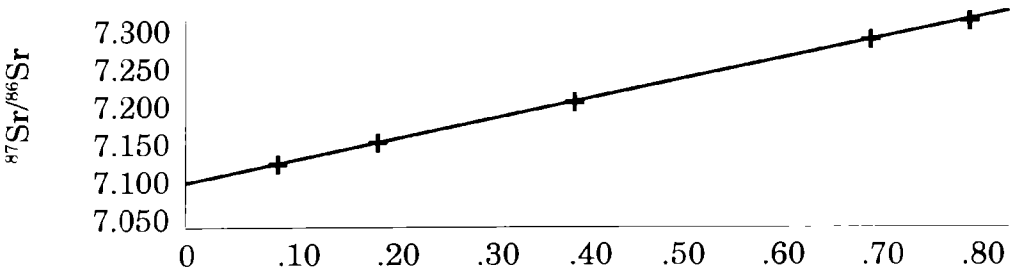
$^{87}Rb = {}^{87}Rb_0\, e^{-kt}$; $^{87}Rb_0 = {}^{87}Rb\, e^{kt}$ — Assumptions 1,3

$^{87}Sr^* + {}^{87}Rb = {}^{87}Rb_0$; $^{87}Sr^* = {}^{87}Rb_0 - {}^{87}Rb = {}^{87}Rb\, e^{kt} - {}^{87}Rb = {}^{87}Rb\, (e^{kt} - 1)$ — Decay products

$^{87}Sr = {}^{87}Sr_0 + {}^{87}Sr^* = {}^{87}Sr_0 + {}^{87}Rb\, (e^{kt} - 1)$ — Assumption 4

$^{87}Sr/^{86}Sr = (^{87}Sr/^{86}Sr)_0 + {}^{87}Rb/^{86}Sr\, (e^{kt} - 1)$ — Assumption 2

By assumption 5 we can measure the appropriate ratios.



Note that where the line crosses the zero line for the $^{87}Rb/^{86}Sr$ ratio gives the original $^{87}Sr/^{86}Sr$ ratio. Any strontium that originally had no rubidium with it would have to have that $^{87}Sr/^{86}Sr$ ratio still. Even if there is no such sample, we can predict its composition using our straight line. The apparent age is found by taking the slope,[51] which in this case is .010/.40 or .025. So $e^{kt} - 1 = .025$, $e^{kt} = 1.025$, and $t = \ln(1.025) / k$. The general formula is $t = \ln(1 + \text{slope}) / k$. We only need 2 points to determine the straight line and thus the slope, but if there are more than 2 points, and all our assumptions are correct, the points should all lie on the same straight line. It is commonly felt that if all the points lie on a straight line, this is a good indication that the above assumptions are correct. Besides, scientists like a straight line, and there are nifty little computer programs for calculating the slope and intercept of the best straight line (the one that passes closest to the most points).

We now turn to how these dates are used in practice. The first paragraph of Faure (whose area of expertise is strontium geochemistry) dealing with experimental results is a shock:

> Igneous rocks of granitic composition may contain both mica minerals and K-feldspar, all of which can be dated by the Rb-Sr method. Ideally, all minerals of an igneous rock should indicate the same date which can then be regarded as the age of the rock. When mineral dates obtained from one rock specimen or from a suite of cogenetic igneous rocks are in agreement, they are said to be "concordant." Unfortunately, "discordance" of mineral dates is more common than "concordance." The reason is that the constituent minerals of a rock may gain or lose radiogenic ^{87}Sr as a result of

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[51] Which is the change in the $^{87}Sr/^{86}Sr$ ratio divided by the change in the $^{87}Rb/^{86}Sr$ ratio.

> reheating during regional or contact metamorphism after crystallization from a magma. In such cases, the mineral dates generally are not reliable indicaters of the age of the rock. We must therefore turn to the rocks themselves if we want to determine their ages.[52]

I thought this was supposed to be a good dating method for minerals. Now we are told that Sr^{++} migrates. Furthermore it does not just re-equilibrate during metamorphism—"(sometimes K-feldspar actually gains ^{87}Sr.)"[53] I have a hard time swallowing that. Isotopic fractionation seems unlikely to be significant with two isotopes as close as ^{87}Sr and ^{86}Sr, and no experimental evidence is alleged to account for this.[54]

But maybe the rubidium/strontium ages of minerals can be explained by metamorphism, and what we really need is whole-rock suites. Surely strontium can't migrate a matter of feet (or meters) in rock that was not melted and stirred. But we are told that " . . . dated by the whole-rock Rb-Sr method. . . . The date indicated by the isochron may be the time of crystallization or the igneous rocks or it may reflect the metamorphic event. . . . The latter is preferred in this case."[55] Also "Whole rock isochrons may *likewise* indicate the age of the metamorphic event during which the sediment was recrystallized."[56] In fact, as Geyh and Schleicher frankly admit, "Although it does not fit the conventional model for Rb/Sr isochron dating, resetting of Rb/Sr whole-rock isochrons by high-grade metamorphism (granulite facies) has been reported (e.g., Burwash et al. 1985)."[57] Furthermore, this migration of strontium "may also occur for rocks that

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[52]Faure, pp. 120-1.

[53]Faure, p. 124.

[54]In fact, the evidence was contrary in 1967, according to Hanson GN, Gast PW: "Kinetic studies in contact metamorphic zones." *Geochim et Cosmochim Acta* 1967;31:1119-53. On p. 1120 Hanson and Gast state, "It is significant that no one has so far been able to thermally induce radiogenic strontium-87 to leave its host mineral in quantities commensurate to the loss of argon under geologically reasonable conditions even though it is not uncommon to find biotites in nature which have lost both radiogenic argon-40 and strontium-87 due to a thermal event." I have not seen any data which would challenge their conclusion.

[55]Faure, pp. 127-8.

[56]Faure, p. 128, italics his.

[57]P. 84, citing Burwash RA, Krupicka J, Basu AR, Wagner PA: "Resetting of Nd and Sr whole-rock isochrons from polymetamorphic granulites, northeastern Alberta." *Canad J Earth Sci* 1985;22:992-1000.

macroscopically appear unaltered. Without an age determination with another method for comparison, it is often not possible to recognize such an isochron as false."[58] So there is at least sometimes massive migration of strontium and possibly rubidium with elevated temperature and/or fluid, which cannot be detected by the usual signs of metamorphism.

But there is evidence against this proposed migration. For example, pyroclastic rocks can be dated "only by their phenocryst minerals (e.g., biotite, muscovite, sanidine). This is a proven procedure for assigning radiometric ages . . ."[59] Notice that tuffs do not equilibrate the strontium in their phenocrysts after deposition. Here, strontium apparently does not migrate even in minerals. In fact, sedimentary rocks, deposited under water, do not homogenize their strontium if the grain size, at least of illite clay, is 2 microns or larger.[60] If strontium doesn't migrate enough to equilibrate in aqueous suspension except possibly with small grain size, why should it have migrated enough to equilibrate across macroscopic collections of whole rock, some of which are presumably much more coarse-grained? (If the strontium moves at all, it has to equilibrate or else it would take incredible luck to avoid ruining the straight line of the isochron.)

Why strontium should easily migrate is not obvious to me anyway. Strontium is doubly charged in minerals, and is poorly soluble in water; generally much less so than (singly charged) potassium or rubidium. Theoretically it should be hard to get strontium to migrate. In fact, one might ask, if argon (a neutral gas) has been retained in a mineral (so that the potassium/argon

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[58]Geyh and Schleicher, p. 87, citing Schleicher H, Lippolt HJ, Raczek I: "Rb-Sr systematics of Permian volcanites in the Schwartzwald (SW Germany). Part II: Age of eruption and the mechanism of Rb-Sr whole rock age distortions." *Contrib Mineral Petrol* 1983;84:281-91. Note that "The Rb-Sr system in these rocks is often disturbed in such a way that the linearity of the sample points is retained in the isochron graph, thus producing apparent isochrons with reduced age values ("rotated isochrons", . . .)".

[59]Geyh and Schleicher, p. 85.

[60]Faure, p. 130, citing Clauer N: "A new approach to Rb-Sr dating of sedimentary rocks." In Jäger E, Hunziker JC (eds): *Lectures in Isotope Geology.* Berlin: Springer-Verlag, 1979, pp. 30-51; Clauer N: "Rb-Sr and K-Ar dating of Precambrian clays and glauconies." *Precambrian Res* 1981;15:331-52; and Bonhomme MG: "The use of Rb-Sr and K-Ar dating methods as a stratigraphic tool applied to sedimentary rocks and minerals." *Precambrian Res* 1982;18:5-25.

age is believable by an evolutionist), why should strontium ions migrate to reduce the rubidium/strontium age?

The explanations for low rubidium/strontium dates seem lame to me. In fact, there seems to be a certain apriorism in their interpretation. For dates that fit the evolutionary time scale, even if the "assumptions are probably not strictly satisfied by any of the common detrital minerals", still, "useful information" is presumed to have been obtained.[61] But if the dates do not fit, even if the rocks appear unaltered, it is because "even a modest increase in temperature of 100 to 200° C or so may have drastic effects on the parent-daughter relationships of natural decay schemes without necessarily being reflected in the usual mineralogical or textural criteria for metamorphism."[62] One might as well say what Dalrymple and Lanphere said regarding potassium/argon dating, that the evolutionary time scale is the ultimate arbiter for radiometric dates.[63] And Faure comes close to making such a statement: "The final test of the validity of dates obtained from clay minerals is that they must *decrease* up-section in a stratigraphic succession of sedimentary rocks."[64] In that case there is no logical reason to regard such biased interpretations as evidence for the evolutionary time scale.

The more logical interpretation is that the rocks are not as old as the conventional ages would make them. But can one then explain those beautiful straight line "isochrons" from the standpoint of a short chronology? It turns out that one can. Suppose that instead of mixing our rock to homogenize the strontium isotopes, allowing the rock to crystallize with partial separation of rubidium from strontium, and then letting the rubidium decay in place, we let the rubidium decay in one rock before mixing it with a rock containing strontium but little or no rubidium. If we do not completely homogenize the two rocks, components will be

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[61]Faure, p. 134.

[62]Faure, p. 123.

[63]Pp. 196-7. The four tests they give are: 1. Direct comparison with other radiometric ages, 2. Direct comparison with fossils, 3. Stratigraphic sequence, and 4. Inference. Note that all but the first test reduce to whether the date fits with the evolutionary time scale, and if the other radiometric methods are chosen on the basis of their "reliability" (how well those methods fit the evolutionary time scale), the first test also reduces to a fit with that scale.

[64]P. 131, italics his. Note the absence of the possibility that to within the limits of the measurement the strata were laid down contemporaneously.

mixed in varying proportions, and the "mixing line" produced is mathematically indistinguishable from an isochron.[65] So a straight line need not imply an accurate age. A mixing line will explain the data just as well (in fact, all 2-component mixing lines are straight lines). All that is required is that ^{87}Rb and ^{87}Sr are initially found together, that is, the $^{87}Sr/^{86}Sr$ and the $^{87}Rb/^{86}Sr$ ratios are both higher in the same rock.

This way of explaining rubidium/strontium dates naturally accounts for systems like the theoretical example given in the figure on p. 85 of Geyh and Schleicher. Whole-rock dating gives a relatively unaltered mixing line. But if there was a certain amount of equilibration between the minerals in a single rock followed by re-separation of rubidium and strontium before it cooled, the slope of the mixing line could be reduced.

Is it realistic to believe that granitic intrusions, for example, do not mix completely? Apparently so. At least Geyh and Schleicher think so; "For example, there are indications that the condition of isotopic homogeniety of a magmatic body at time t_0,

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[65]The mathematical derivation in the simplest case is as follows: In rock A let us suppose there is r rubidium per gram, and s_1 strontium-87 per gram. In rock B let us suppose there is s_2 strontium-87 and t strontium-86 per gram. Then in a mixture of a proportion a of rock A and a proportion b of rock B ($a + b = 1$) there would be $ar + as_1 + bs_2 + bt$ per gram. The $^{87}Sr/^{86}Sr$ ratio would be $(as_1 + bs_2) / bt$ and the $^{87}Rb/^{86}Sr$ ratio would be ar / bt. Thus for a given mixture $^{87}Sr/^{86}Sr = bs_2/bt + (s_1/r)(ar/bt) = (^{87}Sr/^{86}Sr)_b + (^{87}Sr/^{87}Rb)_a {}^{87}Rb/^{86}Sr$. Notice that the plot of $^{87}Sr/^{86}Sr$ versus $^{87}Rb/^{86}Sr$ is a straight line with intercept $(^{87}Sr/^{86}Sr)_b$ and slope $(^{87}Sr/^{87}Rb)_a$, precisely analagous to the isochron plot shown above.

A more complicated but analogous equation giving a straight line can be obtained for impure sources. Given rock A with r_1 ^{87}Rb, s_1 ^{87}Sr, and t_1 ^{87}Sr, and rock B with r_2 ^{87}Rb, s_2 ^{87}Sr, and t_2 ^{86}Sr, we have in any given mixture $^{87}Rb/^{86}Sr = r/t = (ar_1 + br_2)/(at_1 + bt_2)$ and $^{87}Sr/^{86}Sr = s/t = (as_1 + bs_2)/(at_1 + bt_2)$, assuming $t_1 > 0$ and $t_2 > 0$ (both rocks have some ordinary strontium) and a is the proportion of rock A and b is that of rock B (so $a + b = 1$). Then (assuming $r_1/t_1 \neq r_2/t_2$, that is, the two rocks do not have the same ratio of rubidium to ordinary strontium)

$$s/t = (as_1 + bs_2)(r_1t_2 - r_2t_1)/[(at_1 + bt_2)(r_1t_2 - r_2t_1)]$$

$$= (ar_1s_1t_2 - ar_2s_1t_1 + br_1s_2t_2 - br_2s_2t_1)/[(at_1 + bt_2)(r_1t_2 - r_2t_1)]$$

$$= \frac{ar_1s_2t_1 - ar_2s_1t_1 + br_1s_2t_2 - br_2s_2t_2 + ar_2s_2t_2 - ar_1s_2t_1 + br_2s_1t_2 - br_2s_2t_1}{(at_1 + bt_2)(r_1t_2 - r_2t_1)}$$

$$= [(at_1 + bt_2)(r_1s_2 - r_2s_1) + (ar_1 + br_2)(s_1t_2 - s_2t_1)]/[(at_1 + bt_2)(r_1t_2 - r_2t_1)]$$

$$= (r_1s_2 - r_2s_1)/(r_1t_2 - r_2t_1) + [(ar_1 + br_2)(s_1t_2 - s_2t_1)]/[(at_1 + bt_2)(r_1t_2 - r_2t_1)]$$

$$= (r_1s_2 - r_2s_1)/(r_1t_2 - r_2t_1) + (r/t)[(s_1t_2 - s_2t_1)/(r_1t_2 - r_2t_1)],$$

which again is a straight line.

prerequisite for isochron dating of magmatic rock, is not always fulfilled. But for the Rb/Sr system, for example, initial heterogeniety would place the determination of a whole-rock isochron age in doubt, if not make it impossible."[66] For example, "Some granites formed from crustal material by anatectic melting [melting of a previously solidified rock] have yielded only poorly defined isochrons. In some cases it has been shown that the scatter is not caused by secondary post-magmatic disturbances, but by incomplete homogenization of the anatectic melt . . ."[67] But if incomplete mixing can also give straight "isochrons", there is no reason to suppose that any "isochron" necessarily shows true age. The isochron method of rubidium/strontium dating is not "self-checking".[68]

In fact, when faced with "isochron" lines that are grossly too old even by the evolutionary time scale, geochronologists have no trouble ascribing them to mixing lines. Several examples are given in Faure.[69] One can even have a backward "isochron" (giving a negative "date"), which is universally conceded to be a mixing line.[70] Thus a creationist explanation of other "isochrons" as mixing lines is not out of order.

It may be pertinent to note that in order to completely reset

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[66]Pp. 12-13.

[67]Geyh and Schleicher, p. 87.

[68]Contrary to the claim of Dalrymple, see note 9, p. 109.

[69]Pp. 145-7. His examples follow: Pleistocene to Recent (<1.6 million years old) lava with a Rb/Sr age of 773 million years (Bell K, Powell JL: "Strontium isotopic studies of alkalic rocks: The potassium-rich lavas of the Birunga and Toro-Ankole Regions, east and central Africa." J *Petrol* 1969;10:536-72); upper Miocene to Pliocene (5-9 million years old by K/Ar dating) lava with a Rb/Sr age of 31-39 million years (Dickinson DR, Dodson MH, Gass IG, Rex DC: "Correlation of initial $^{87}Sr/^{86}Sr$ with Rb/Sr in some late Tertiary volcanic rocks of south Arabia." *Earth Planet Sci Lett* 1969;6:84-90); Pliocene to Holocene (<5.3 million years old) lava giving Rb/Sr ages of 570 and 870 million years (the 570 million year "isochron" is apparently from <3000 year old lava. Leeman WP, Manton WI: "Strontium isotopic composition of basaltic lavas from the Snake River Plain, southern Idaho." *Earth Planet Sci Lett* 1971;11:420-34); and Miocene to Holocene (<24 million years old) volcanic rock with a Rb/Sr age of 1.2 billion years (Duncan RA, Compston W: "Sr-isotopic evidence for an old mantle source region for French Polynesian vulcanism." *Geology* 1976;4:728-32). An additional report has been made of Pliocene to Holocene (<5.3 million years old) lava with a Rb/Sr age of 1.5 billion years (Leeman WP: "Late Cenozoic alkali-rich basalt from the western Grand Canyon area, Utah and Arizona: Isotopic composition of strontium." *Bull Geol Soc Am* 1974;85:1691-6).

[70]For an example, see Dasch EJ, Green DH: "Strontium isotope geochemistry of lherzolite inclusions and host basaltic rocks, Victoria, Australia." *Am J Sci* 1975;275:461-9.

an isochron, strontium istopes must completely homogenize, to the nearest part per 10,000 or so, without homogenizing rubidium, or at least with subsequent refractionation of rubidium. If one simply mixes rubidium along with strontium, one has a mixing line with the same slope as the original isochron. This would make it more difficult to assume re-equilibration.

What about the apparent order in rubidium/strontium dates? Some of it is more apparent than real, due to the biases we noted under potassium/argon dating. But there is a real order as well. This might be accounted for by more complete mixing of the starting components for mixing lines as the Flood went on, with flatter "isochrons" as a result. And what about the matching of rubidium/strontium dates with potassium/argon dates? Some of the dates do not match.[71] This fact is not as generally appreciated as it should be. But even matched dates do not necessarily correspond with real time. Dalrymple and Lanphere[72] note some nearly parallel potassium/argon and rubidium/strontium dates which no one would say represented real time. Whether the data were somehow biased or whether there is some non-chronological relationship between the two systems I cannot say for sure, but certainly the relationship does not have to be chronological to give concordant "dates".

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[71]For example, see Odin GS (ed): *Numerical Dating in Stratigraphy.* Chinchester: John Wiley and Sons, 1982. Chapter 12 (Keppens E, Pasteels P: "A comparison of rubidium-strontium and potassium-argon apparent ages on glauconies." Pp. 225-44) is full of examples of disagreement, and also has examples where the two methods agree but both differ from the accepted age. One may argue that glauconies are not always reliable, but examples of "incorrect" dates from other minerals such as biotite and whole rock granite may be found in chapter 24 (De Souza HAF: "Age data from Scotland and the Carboniferous time scale." Pp. 455-66), for example. Also see Lanphere MA, Wasserburg GJF, Albee AL, Tilton GR: "Redistribution of strontium and rubidium isotopes during metamorphism, World Beater Complex, Panamint Range, California." In: Craig H, Miller SL, Wasserburg GJ (eds): *Isotopic and Cosmic Chemistry.* Amsterdam: North-Holland Publishing Company, 1964, pp. 269-320. This fascinating study also demonstrates whole-rock (separated by, in some cases, miles) dates 200 million years younger than the presumed age of the formation (1.8 billion years), as well as up to 50% disparity between potassium/argon and rubidium/strontium mineral ages, in spite of minimal to no mineralogical evidence of metamorphism at this time (presumably 115 million years ago).

[72]Pp. 160-1, citing Hart SR: "The petrology and isotopic-mineral age relations of a contact zone in the Front Range, Colorado." *J Geol* 1964;72:493-525, and especially Hanson and Gast, see note 54.

Is there some mineral or rock that one might reasonably assume had complete initial homogenization of its strontium isotopes so that we can get a minimum rubidium-strontium age for deposition? Yes, there is. Evaporite minerals would be expected to have had all their strontium either in solution or equilibrium with solution at the time of deposition. But evaporites turn out to be a real can of worms. For it is not certain whether so-called evaporites are actually formed by evaporation. It is certain that most of them are not formed by the evaporation of seawater.[73] Their minerals do not always lie on a straight "isochron" line,[74] implying either an unusual recrystallization history or a complex mixing line. And their dates, although quite low, are mostly not in harmony with a creationist model.[75] The problems for a creationist would be neatly solved if some of the crystals were transported in, or even if the minerals were crystallized in different stages. From an evolutionary perspective, migration of strontium seems implausible, but re-solution is much more plausible. In conclusion, the evidence from rubidium/strontium dating, as well as that from potassium/argon dating, points in the direction of a short chronology for life on the earth. The difficulties of interpretation within an evolutionary time scale are far worse than those within a creationist time scale.

Two other methods are analogous to rubidium/strontium dating and stand or fall with it. *Potassium/calcium dating* is strictly analogous. The only change in the formulas is the addition of a factor for the branched decay of 4^0K.[76] In fact, the chemistry is

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[73]See Hardie in note 37.

[74]See Baadsgaard in note 36.

[75]Lippolt HJ, Raczek I: "Rinneite-dating of episodic events in potash salt deposits." *J Geophys* 1979;46:225-8 (Rinneite [NaK_3FeCl_6] of Permian [250-300 million years old] age gave dates of 30-85 million years old by "model age" [the initial $^{87}Sr/^{86}Sr$ was estimated] and another sample gave 20 million years by actual isochron, but carnallite [$KCl{\cdot}MgCl_2{\cdot}6H_2O$] found with the rinneite did not fall on the isochron, dating instead to 8.5 million years); Lippolt HJ, Raczek I: "Cretaceous Rb-Sr total rock ages of Permian salt rocks." *Naturwissenschaften* 1979;66:422-3 (two samples of these Permian potassium minerals gave ages of 82 ± 1 and 96 ± 1 million years within 10 feet of each other on the same horizon); and Baadsgaard in note 36.

[76]The equation being $^{40}Ca/^{42}Ca = (^{40}Ca/^{42}Ca)_0 + (^{40}K/^{42}Ca) \times 0.888 \times (e^{kt} - 1)$ for the isochron line. The equation can also use ^{44}Ca or some other isotope as its reference instead of ^{42}Ca.

similar. Potassium and rubidium are nearly interchangeable and are found together, and the same is true for calcium and strontium. It is therefore not surprising that the few potassium/calcium ages that have been determined matched the rubidium/strontium ages for the same rocks. It is of interest that evaporites, for which one can be the most comfortable that isotopic homogenization has occurred, again usually date low.[77] Potassium/calcium dating, like rubidium/strontium dating, is actually more compatible with a short than a long chronology.

The $^{147}Sm/^{143}Nd$ method depends on the decay of ^{147}Sm to ^{143}Nd by the ejection of an alpha particle, with a decay constant of 6.539×10^{-12}/year (and therefore a half life of 106 billion years). The isochron method is again used.[78] The same criticisms apply to this method as to the rubidium/strontium method, but this method has the additional disadvantage for our purposes of being hard to reset by anyone's standards.[79] Finally, the long half-life of ^{147}Sm means that most samarium/neodymium dates are precambrian. Samarium/neodymium dating can be safely ignored in the present discussion.

Uranium/Thorium/Lead methods. These are three interrelated methods that all depend on the decay of a long-lived isotope (^{238}U, half life 4.468×10^9 years, ^{235}U, half life 7.038×10^8 years,

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[77]Some studies (for example, Wilhelm HG, Ackerman W: "Altersbestimmung nach der K-Ca-Methode an Sylvin des Oberen Zechsteines des Werragebietes." *Z Naturforsch* 1972;27a:1256-9; and Heumann KG, Kubassek E, Schwabenbauer W, Stadler I: "Analytisches Verfahren zur K/Ca-Altersbestimmung geologischer Proben." *Fresenius Z Anal Chem* 1979;297:35-43) use model ages instead of isochrons. Heumann *et al.* dated langbeinite (potassium magnesium sulfate) with a potassium/argon age of 147 million years and a rubidium/strontium age of 152 million years, to 154 million years (the geological age was not given). The sylvite of Wilhelm and Ackerman, with a geological age of 200 million years, dated 133 million and 40.5 million years. Wilhelm and Ackerman attributed this to metamorphosis and recrystallization, without citing any other evidence for these processes.

It is fascinating to note Baadsgaard's data (see note 36), especially on the Alwinsal Willowbrook core. With rubidium-strontium dating the sylvite gives 20-60 million years, and the carnallite gives 2-20 million years, whereas the potassium-calcium dates are 4-85 million years and 85-125 million years, respectively. Notice the reversal of the (apparent) relative ages (the conventional age is 350 million years and the potassium/argon age is 200 million years).

[78]The formula is $^{143}Nd/^{144}Nd = (^{143}Nd/^{144}Nd)_0 + (^{147}Sm/^{144}Nd)(e^{kt} - 1)$.

[79]For example, see Geyh and Schleicher, p. 103: "This example clearly shows the high resistence [*sic*] of the Sm-Nd system to metamorphic resetting."

and ^{232}Th, half life 1.4010×10^{10} years), through several steps, to lead. Each isotope listed above produces a different isotope of lead[80] (^{238}U yields ^{206}Pb, ^{235}U yields ^{207}Pb, and ^{232}Th yields ^{208}Pb) through several steps of alpha and beta decay. For now we will not worry about the intermediate steps.[81] For our purposes, once the uranium or thorium decays, it can be considered to have produced the proper isotope of lead immediately as a good approximation, if the evolutionary time scale is close to accurate.

These are essentially isochron methods. One can assume an invariant decay constant, initial homogenization of lead, and no migration of uranium, thorium, any of their daughter products, or lead, and no removal of ^{235}U by neutron-induced fission.[82] One then makes isochron plots as in rubidium/strontium dating,[83] and in theory obtains three different dates which should all be concordant if the above assumptions are correct. If the dates are concordant, the conclusion is usually drawn that the calculated age represents real age.

Two criticisms of these methods can be made. First, even concordant dates can be precisely duplicated by mixing lines, just as in rubidium/strontium dating. Concordance may suggest that a deposit was last separated into uranium (and thorium) and lead fractions at a given time, but it does not prove that the last time it was made into a hot slurry was that long ago. This is particularly true for whole-rock dating, but is true for mineral dating as

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[80]Abbreviated Pb, from the Latin plumbum, from which we get the English word plumbing.

[81]This is because the methods under discussion are only used to date materials 1 million years old or older. The longest-lived intermediate is ^{234}U with a 245,000 year half life. The other mean lives added together are less than 120,000 years for any series.

[82]There is one place in Africa where this assumption is probably not true, the Oklo uranium deposit. About half the ^{235}U has probably been fissioned.

[83]The equations are:

$$^{206}Pb/^{204}Pb = (^{206}Pb/^{204}Pb)_0 + (^{238}U/^{204}Pb)(e^{kt} - 1)$$
where $k = 1.55125 \times 10^{-10}$/year,

$$^{207}Pb/^{204}Pb = (^{207}Pb/^{204}Pb)_0 + (^{235}U/^{204}Pb)(e^{kt} - 1)$$
where $k = 9.8485 \times 10^{-10}$/year, and

$$^{208}Pb/^{204}Pb = (^{208}Pb/^{204}Pb)_0 + (^{232}Th/^{204}Pb)(e^{kt} - 1)$$
where $k = 4.9475 \times 10^{-11}$/year.

There is also a $^{207}Pb/^{206}Pb$ age which is obviously mathematically interrelated with the uranium/lead methods, and as noted above, is only considered valid on precambrian age material anyway, and will not be given separate consideration here.

well, since zircon is especially resistant to melting.[84]

Secondly, in practice "The ages obtained with the above equations are almost always discordant."[85] This would imply that almost none of the deposits which are dated by the uranium/thorium/lead methods have been undisturbed since the last time the uranium/thorium/lead clocks were completely reset. This would invalidate the dating methods unless there is some way of mathematically correcting for the age discrepancies.

These considerations have led to the concordia method of uranium/lead dating. It is difficult to determine the relative movement of uranium and thorium into or out of a rock or mineral if movement has taken place after formation. Therefore, it is difficult to relate thorium/lead dating to uranium/lead dating in a specimen which is assumed to have been disturbed. But the two uranium isotopes should migrate together, as should the different lead isotopes, and so the $^{238}U/^{206}Pb$ age and the $^{235}U/^{207}Pb$ age can be related to each other. If we assume that the uranium in the sample was initially lead-free (or if we correct for primordial lead based either on the isotope ratios of nearby lead without uranium or on the use of isochron methods), the $^{238}U/^{206}Pb$ ratio will give an age and the $^{235}U/^{207}Pb$ ratio will give an age. Where the ratios give the same age is called the concordia line (this is not a *straight* line). If a sample has aged (for example, 3 billion years) and then loses lead[86] or gains uranium, its uranium/lead ratios move from where it is on the concordia line along a straight line, called the discordia line, toward the origin. If the uranium/lead clocks are not completely reset (the lead is not completely removed and does not have its isotopic composition completely homogenized), the various rocks will have their uranium/

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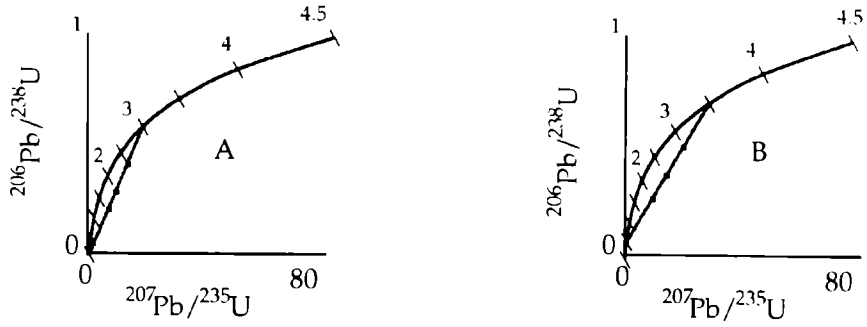
[84]See Gale NH: "The dating of plutonic events." In Odin GS (ed), see note 71, pp. 441-50: "Even though, [*sic*] a zircon suite may be well-dated by the U-Pb discordia method . . . , there can still be doubt whether this date is that of the rock formation itself or whether the zircons are detrital or have inherited radiogenic lead, resulting in the U-Pb result giving an 'age' older than the rock formation. (This danger is also inherent in fission track ages of zircons from bentonites.)" (pp 446-7).

[85]Geyh and Schleicher, p. 117.

[86]This movement of lead can occur in zircons exposed to seawater under high pressure and temperature in a relatively short time (up to 61% lead loss at 13 d in 2M NaCl at 1Mbar and 500° C) according to Pidgeon RT, O'Neil JR, Silver LT: "Uranium and lead isotopic stability in a metamict zircon under experimental hydrothermal conditions." *Science* 1966;154:1538-40.

lead ages "stuck" at varying distances down the discordia line. Then as more uranium decays and more lead accumulates the discordia line gradually moves, but remains a straight line. At a later time one can not only date the original age of the sample (the "upper concordia age") but also the time of the disturbance (the "lower concordia age"). From the standpoint of our discussion the meaning of the upper concordia age is not terribly important, as these dates are almost always Precambrian. But the lower concordia age often falls into the Phanerozoic, so the meaning of this age is quite germane to our discussion.



Discordia lines: A. Initial B. after 500 million years

There is an elaborate discussion of discordia lines in both Geyh and Schleicher[87] and Faure[88] which I will not repeat here. In some cases a discordia line can make a certain amount of sense from an evolutionary geological perspective. However, "In many Archaean areas the lower intercept gives an age value that cannot be assigned to any known geological event. This secondary value is then viewed as meaningless."[89] So some lower concordia

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[87]Pp. 117-27.

[88]Pp. 291-9.

[89]Geyh and Schleicher, p. 121. See also p. 124: "A multi-stage history of detrital zircon or monazite can produce a pseudo-linear plot with intercepts between discrete metamorphic events, which are then without geological meaning." What is a "pseudo-linear plot"? It would seem to be a linear plot which we do not like. In that case how do we know that an ordinary "linear plot" has geological meaning except that we want to believe it?

Some examples of lower concordia ages which are not realistic from anyone's perspective are given in Tilton GR: "Volume diffusion as a mechanism for discordant lead ages." J *Geophys Res* 1960;65:2933-45. Another example is given in Kuovo O, Tilton GR: "Mineral ages from the Finnish Precambrian." J *Geol* 1966;74:421-42.

ages are difficult to explain from an evolutionary perspective using standard theory.[90]

Is there another way to get those straight lines? Yes, a discordia line can be precisely reproduced by a mixing line (in fact, the original discordia line to the origin is just a special case of such a mixing line).[91] Mixing lines would seem to be the easi-

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[90]This problem has been felt so acutely that several diffusion models have been developed to explain "invalid" lower concordia dates. The most prominent of these have been the constant diffusion model (Tilton GR, see note 89) and the radiation damage-induced diffusion model (Wasserburg GJ: "Diffusion processes in lead-uranium systems." *J Geophys Res* 1963;68:4823-46). However, these models would be expected to be universal, or at least universal given certain parameters, and there are multiple examples of discordia lines which cannot reasonably be made to fit diffusion models (See, for example, Catanzaro EJ: "The interpretation of zircon ages." In Hamilton EI,Farquhar RM (eds): *Radiometric Dating for Geologists.* London: Interscience Publishers, 1968; and Ludwig KR, Stuckless JS: "Uranium-lead isotope systematics and apparent ages of zircons and other minerals in precambrian granitic rocks, Granite Mountains, Wyoming." *Contrib Mineral Petrol* 1978;65:243-54). But note that even if the diffusion model were correct, it would still invalidate lower concordia ages as representing real time.

[91]This solution to the problem was noted in Steiger RH, Wasserburg GJ: "Comparative U-Th-Pb systematics in 2.7 x 10^9 yr plutons of different geologic histories." *Geochim Cosmochim Acta* 1969;33:1213-32. The derivation is as follows: We will take two rocks, Rock 1 with P_1 ^{206}Pb, U_1 ^{238}U, Q_1 ^{207}Pb, and V_1 ^{235}U, and Rock 2 with P_2 ^{206}Pb, U_2 ^{238}U, Q_2 ^{207}Pb, and V_2 ^{235}U. We will define for any rock $P/U = R$ and $Q/V = S$. The concordia plot is then R versus S, and the discordia line becomes $R = aS + b$. We note that for any rock U/V is a constant, so that $U_1/V_1 = U_2/V_2$ and $U_1V_2 = U_2V_1$. We will assume that there is some uranium in both rocks, so that $U_1 > 0 < U_2$ (and $V_1 > 0 < V_2$).

In a given mixture with x amount of Rock 1 and (1-x) amount of Rock 2 we have

$$R = P/U = (xP_1 + (1\text{-}x)P_2) / (xU_1 + (1\text{-}x)U_2) = (P_2 + x(P_1\text{-}P_2)) / (U_2 + x(U_1\text{-}U_2)),$$
$$RU_2 + Rx(U_1\text{-}U_2) = P_2 + x(P_1\text{-}P_2), \quad \text{and} \quad x(R(U_1\text{-}U_2) - (P_1\text{-}P_2)) = P_2 - RU_2.$$

By a precisely analogous derivation we have

$$Q_2 - SV_2 = x(S(V_1\text{-}V_2) - (Q_1\text{-}Q_2)).$$

Multiplying the equations by each other and dividing by x, we have

$$(R(U_1\text{-}U_2) - (P_1\text{-}P_2))(Q_2 - SV_2) = (S(V_1\text{-}V_2) - (Q_1\text{-}Q_2))(P_2 - RU_2).$$

(This equation is valid even if $x = 0$, for in that case

$$R = R_2 = P_2/U_2 \quad \text{and} \quad P_2 - RU_2 = P_2 - P_2 = 0,$$

and similarly $Q_2 - SV_2 = 0$, so that the above equation reduces to $0 = 0$ and is still correct.)

Multiplying out, we have

$$RQ_2U_1 - RSU_1V_2 - RQ_2U_2 + RSU_2V_2 - P_1Q_2 + SP_1V_2 + P_2Q_2 - SP_2V_2$$
$$= SP_2V_1 - RSU_2V_1 - SP_2V_2 + RSU_2V_2 - P_2Q_1 + RQ_1U_2 + P_2Q_2 - RQ_2U_2.$$

Collecting terms,

$$RS(U_2V_1 - U_1V_2) + R(Q_2U_1 - Q_1U_2) = S(P_2V_1 - P_1V_2) + (P_1Q_2 - P_2Q_1).$$

est explanation for the "meaningless" age values for lower concordia ages noted above. If that is the case, then mixing lines might also explain ages which were previously presumed to have geological meaning. Lower concordia ages would then no longer have the persuasive power that has usually been assumed for establishing a date for a phanerozoic deposit. A straight line does not require an accurate lower concordia age. The discordia method is not "self-checking".[92]

Is a mixing line a believable mechanism for discordia lines? Certainly for whole-rock dating a mixing line makes sense (and much of the dating that is done is whole-rock dating). For collections of zircons extracted from whole rock it also makes sense. Even if the dating is done on individual zircon crystals it would make sense unless uranium is consistently incorporated into zircon without lead. This would seem to require the uranium to be incorporated one atom at a time as an integral part of the zircon crystal structure.

The only requirement left of a creationist theory would be to explain the trend of dates to roughly match evolutionary theory. A general trend from older dates in earlier (i. e., lower) rocks to younger dates in later rocks could be explained by the gradually more thorough melting and mixing of the minerals in question as the Flood progressed. And of course there is some natural selectivity in what is published.

However, before we leave uranium/lead dating, attention should be drawn to a fascinating set of observations published in 1976.[93] Some uranium-rich water percolated through mesozoic coal (conventional dates over 100 million years old), depositing uranium and its daughter products. From pleochroic haloes of ^{210}Po found in the coal it was reasonably shown that the uranium solution infiltrated the coal before coalification was com-

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Since $U_1V_2 = U_2V_1$, $RS(U_2V_1 - U_1V_2) = 0$,
and $R(Q_2U_1 - Q_1U_2) = S(P_2V_1 - P_1V_2) + (P_1Q_2 - P_2Q_1)$, or (if $Q_2U_1 - Q_1U_2 \neq 0$)
$R = S(P_2V_1 - P_1V_2) / (Q_2U_1 - Q_1U_2) + (P_1Q_2 - P_2Q_1) / (Q_2U_1 - Q_1U_2)$, which is a straight line. If $Q_2U_1 - Q_1U_2 = 0$, then $S(P_2V_1 - P_1V_2) = (P_2Q_1 - P_1Q_2)$, which gives a vertical straight line. Thus *a mixing line of any two uranium-bearing rocks will always give a straight line on a concordia plot.*

[92]Contrary to the claim of Dalrymple, see note 9, p. 119.

[93]Gentry RV, Christie WH, Smith DH, Emery JF, Reynolds SA, Walker R, Cristy SS, Gentry PA: "Radiohalos in coalified wood: New evidence relating to the time of uranium introduction and coalification." *Science* 1976;194:315-8.

plete, and that coalification was completed roughly1-10 years from the time polonium (and therefore probably uranium) deposition began.

The uranium did not deposit evenly. Instead, it formed small inclusions which had haloes, mostly without the outer, last-stage haloes. Uranium/lead ratios were measured in several of these inclusions. The ratios ranged from 2,230:1 to 27,300:1 and even higher (unmeasurable lead content). This would appear to give a date of less than 300,000 years—how much less is anyone's guess. Movement of lead would seem to be unlikely when lead inclusions 50 microns away seemed intact, and it would take massive movement of uranium to explain these dates on an evolutionary basis.

To my knowledge the raw data has not been challenged. Attempts to explain the data by impugning the analytical methods would seem to apply equally to evolutionary dates. And since there is radiogenic lead in these samples not associated with uranium, the experimental results suggest that whole rock dating is not valid unless, as a minimum requirement, the lead can be demonstrated to be microscopically in the same place as the uranium.

Lead/alpha dating is just a watered-down and much less sophisticated version of uranium/thorium/lead dating. It is done by counting the alpha activity in the sample, measuring the lead content, and assuming no initial lead.[94] It is not able to take primordial lead into account, as uranium/thorium/lead dating does, and should date rocks to a somewhat older age than the average of uranium/thorium/lead dates. It is not worthy of independent consideration.

Uranium series disequilibrium methods: The uranium series disequilibrium methods include several methods which utilize the daughter products of ^{238}U and ^{235}U. The methods that concern us are the $^{230}Th/^{234}U$ method, the $^{231}Pa/^{235}U$ method, the $^{231}Pa/^{230}Th$ method, the $^{234}U/^{238}U$ method, the $^{230}Th_{excess}$ method, the $^{231}Pa_{excess}$ method, the $^{230}Th_{excess}/^{232}Th$ method, the $^{231}Pa_{excess}/^{230}Th_{excess}$ method, and the $^{226}Ra_{supported}$ and $^{226}Ra_{unsupported}$ methods. The principles for each of them are similar, so they will be considered together, starting with the best-documented. The reliability of these methods is currently assessed

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[94]The lead/alpha method is nearly equivalent to the chemical lead method, which is obsolete.

on the basis of several criteria:

> -The sample must have a uranium content of >10 ppb, >1 ppm is better.
> -Terrestrial carbonates should have contained no ^{232}Th at the time of formation.
> -Coral (aragonite, less than 1% calcite), mollusc shells, speleothem, and travertine should be compact, impervious to water, and may show no signs of weathering. They must have formed a closed system (Schwarcz 1980).
> -There may be no signs of diagenetic recrystallization, which could have mobilized uranium or subsequent disintegration products (Geyh and Henning [sic] 1986). Thus, for example, primary aragonite samples (e.g., mollusc shells or coral) may not contain any calcite.
> -The proportion of acid-insoluble residue must be <5% and the $^{230}Th/^{232}Th$ activity ratio of terrestrial carbonate should be >20.
> -The $^{226}Ra/^{230}Th$ and $^{234}U/^{238}U$ activity ratios of marine samples older than 70 ka should be in the range of 1.0 ± 0.1 and 1.14 ± 0.02, respectively.
> -The radiometric age should be consistent with the stratigraphic data.
> -Dates obtained using different methods, e.g., $^{230}Th/^{234}U$ (Sect. 6.3.1), $^{231}Pa/^{235}U$ (Sect. 6.3.2), ^{230}Th-excess (Sect. 6.3.5), ^{231}Pa-excess (Sect. 6.3.6), U/He (Sect. 6.3.14), and ^{14}C (Sect. 6.2.1), should agree.
>
> If even one of these criteria is not fulfilled, the results cannot be expected to be reliable.[95]

This means that if authors and editors adhere to these criteria (especially the last two), no dates will ever be published that disagree with either the evolutionary time scale ("the stratigraphic data") or with the standard interpretation of ^{14}C dating.[96] Therefore we can expect to see biased data. If the evolutionary time

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[95]Geyh and Schleicher, p. 213, citing Thurber DL, Broecker WS, Blanchard RL, Potratz HA: "Uranium-series ages of Pacific Atoll coral." *Science* 1965;149:55-8.

[96]That it is intended to be applied this way can be inferred from Geyh and Schleicher, p. 222. Discussing methods for the "correction" of data, and noting their limitations, the authors state, "However, as none of these methods is entirely satisfactory, samples should be selected that will yield reliable ages with a high probability." Reliable in what way? Giving the desired ages, or theoretically uncomplicated? If the former, then gross bias is introduced.

scale is correct, then the data will be biased in the proper direction; but for the question as to the validity of that scale, the published data are nearly worthless. Thus even impressive data like that of Bard *et al.*[97] are not that helpful, since we have no way of knowing how many studies with different results never got completed, or wound up unpublished.[98]

But on to the methods themselves. They are dependent on having known initial amounts (or concentrations) of a parent and a corresponding daughter nuclide (or two independent nuclides) which have presumably been immobilized in the past, and measuring the state of progression of the relevant nuclides toward equilibrium.

The $^{230}Th/^{234}U$ method, considered the most reliable, starts by assuming that no ^{230}Th is found in a sample at the time of closure of the system. The ^{234}U initially in the system decays to ^{230}Th with a half life of 248,000 years. The ^{230}Th itself decays with a half life of 75,200 years. With appropriate measurements of the $^{238}U/^{234}U$ and $^{230}Th/^{234}U$ ratios, a formula relating the age and the above ratios may be derived.[99] The age itself is found by

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[97]Bard E, Hamelin B, Fairbanks RG, Zindler A: "Calibration of the ^{14}C timescale over the past 30,000 years using mass spectrometric U-Th ages from Barbados corals." *Nature* 1990;345:405-10. It should perhaps be noted that they cited disagreements between the presumed original $^{14}C/C$ ratios of previously dated varved sediments, U-Th dating, and ice cores of up to 100% (p. 406).

[98]Because of this bias, the situation is a little like arguing that the economy in a Marxist country is doing well because the news reports are always good. If one believes in Marxism then they are reassuring evidence. But if one is trying to decide whether Marxist doctrine is correct, then the systematic bias makes the data unimpressive.

This analogy should not be pushed too far. There is a major difference between scientific and Marxist reports. Science values truth, honesty, and trustworthiness, whereas Marxism is quite willing to dispense with them if it suits its purposes. Thus, although science has its Piltdown men, their perpetrators are disapproved even by evolutionists. Most of the time one can at least trust the raw data, whereas this is not true at all for Marxist propaganda. Reports of violent students at Tiannenmen Square are quite likely to be simply fabricated.

[99]The equation is

$$\frac{[^{230}Th]}{[^{234}U]} = \frac{k_{230}}{k_{230} - k_{230}}\left(1 - \frac{[^{238}U]}{[^{234}U]}\right)\left(1-e^{-(k_{234} - k_{230})t}\right) + \frac{[^{238}U]}{[^{234}U]}\left(1-e^{-k_{230}t}\right)$$

(the brackets indicate alpha activity ratios rather than atomic ratios). One is tempted to think that for practical purposes the alpha activity of ^{234}U should be equal to that of ^{238}U. However, it turns out that the uranium in water is relatively enriched in ^{234}U, so that in groundwater the decay of ^{234}U is greater than that of ^{238}U by a factor of as much as 10 or more. Seawater today usually has an activity ratio of 1.15. If it were not for this the equation would be much simpler.

interpolation as the formula cannot be solved explicitly for time.

The method depends on four assumptions:

1. The decay constants have been invariant.
2. The initial ^{230}Th concentration was zero
3. There has been no net migration of ^{238}U, ^{234}Th, ^{234}Pa, or ^{234}U.
4. There has been no net migration of ^{230}Th.

For the purposes of our discussion we will grant assumption 1. The chief complaint of evolutionists concerns the acquisition of uranium by the specimen. If additional uranium is introduced, the radiometric ages will be too low. This apparently happens quite commonly.[100] (This would be viewed differently by a creationist.) There is also evidence that thorium may not be retained by some specimens. Because thorium is not supposed to be soluble in seawater, this seems theoretically improbable, but since thorium loss is apparently required to make some ages fit an evolutionary model, it is assumed to have occurred.[101] Apparently leaching of uranium also occurs, giving ages too old even for evolutionists.[102] Whether this effect is absent for dates which agree with the evolutionary time scale would appear to be a matter of opinion. Also adding of ^{230}Th apparently can occur, sometimes without any physical indication of a problem.[103]

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[100]For example, see Geyh and Schleicher, p. 225: "Even when all of the rules are observed, incorrect data are sometimes obtained. A frequent reason is the presence of an open system, which is often the case with bones, teeth, marine phosphorites (Burnett and Kim 1986), and marine mollusc shells (Kaufman et al. 1971; Ivanovich et al. 1983), all of which acquire uranium in complex, episodic processes." The references cited are Burnett WC, Kim KH: "Comparison of radiocarbon and uranium-series dating methods as applied to marine apatite." *Quat Res* 1986;25:369-79; Kaufman A, Broecker WS, Ku T-L, Thurber DL: "The status of U-series methods of mollusk dating." *Geochim Cosmochim Acta* 1971;35:1155-83 (a thorough and devastating review); and Ivanovich M, Vita-Finzi C, Hennig GJ: "Uranium-series dating of molluscs from uplifted Holocene beaches in the Persian Gulf." *Nature* 1983;302:408-10.

[101]See Geyh and Schleicher, p. 225: "In addition, Rae and Hedges (1989) have demonstrated that under certain circumstances not only uranium but also thorium may become mobile. Cross sampling often yields significantly lower ages than the burial age." They are citing Rae A, Hedges REM: "Further studies for uranium-series dating of fossil bone." *Appl Geochem* 1989;4:331-7. The results of Rae and Hedges seemed to indicate that bone took up thorium in groundwater experimentally. This would invalidate the whole dating procedure for bone, and suggest its invalidity elsewhere. It would be fascinating to see whether coral, for example, also can take up thorium from seawater.

[102]Geyh and Schleicher, pp 225-6.

[103]"In spite of this correction for detritus, U/Th ages obtained for Holocene stalagmites are often too large by several thousand years with no suggestion of

Perhaps most devastating for the validity of the dating method, one can have "unknown, non-zero initial specific activities of the ^{230}Th in samples taken from different cores."[104] If one cannot be assured of initially zero ^{230}Th activity, the basis of the method falls apart. Apparently this initial ^{230}Th is felt to come partly from seawater and partly from terrestrial detrital particles. Of course the concentration of the latter would be expected to have been much higher during and shortly after a Flood, almost *ex hypothesis*. Therefore the method would appear to be theoretically incapable of proving the validity of the evolutionary time scale (by the same token, it would be very unlikely that it could prove a creationist time scale). We might conclude by saying that $^{230}Th/^{234}U$ dating is not very helpful in our quest. The significance of $^{230}Th/^{234}U$ ages is greatly limited.

The $^{231}Pa/^{235}U$ method is closely analogous to the $^{230}Th/^{234}U$ method. It uses the assumption that ^{235}U is transported into a material without any ^{231}Pa. The ^{235}U then decays (via short-lived ^{231}Th) to ^{231}Pa.[105] The same criticisms that apply to the $^{230}Th/^{234}U$ method apply to this method. In addition, ^{231}Pa is acknowledged to be more mobile than ^{230}Th (although the inference usually drawn is that it may be lost, rather than that it may be gained).[106] The literature contains frequent estimates of ^{231}Pa loss and prolonged ^{235}U gain, to account for ages younger than expected using an evolutionary time scale. This method does not present a serious challenge to a creationist time scale.

The $^{231}Pa/^{230}Th$ method utilizes a mathematical division of the equation for the $^{231}Pa/^{235}U$ method by the equation for the $^{230}Th/^{234}U$ method. It is not really an independent method, and does not need further consideration in this discussion.

The $^{234}U/^{238}U$ method is based on the observation that minerals formed in equilibrium with water contain an excess of ^{234}U with respect to ^{238}U (excess decays per minute, not excess at-

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any detrital component indicated by the presence of ^{232}Th (Geyh and Hennig 1986)." Geyh and Schleicher, p 226, citing Geyh MA, Hennig GJ: "Multiple dating of a long flowstone profile." *Radiocarbon* 1986;28(2A):503-9.

[104]Geyh and Schleicher, p. 221.

[105]The formula for ^{231}Pa activity is closely approximated by $[^{231}Pa/^{235}U] = 1 - e^{-kt}$, where k is the decay constant of protactinium-231, 2.021×10^{-5}/year, corresponding to a half life of 34,300 years.

[106]Geyh and Schleicher, p. 230.

oms). This excess (or disequilibrium) is presumably because minerals containing uranium are damaged at the sites where ^{238}U has partially decayed, so the resultant ^{234}U is therefore more available for solution than undecayed ^{238}U. Seawater is enriched in ^{234}U compared to uranium ore, and groundwater is still more enriched. If one knows the original $^{234}U/^{238}U$ activity ratio one can closely approximate the time by $t = \ln([^{234}U/^{238}U - 1]_0 / [^{234}U/^{238}U - 1]) / k$, where $[^{234}U/^{238}U]$ is the activity ratio rather than the molar or weight ratio. However, without knowledge of $[^{234}U/^{238}U]_0$, time cannot calculated. And there are no reliable estimates for this initial ratio.[107] Thus this method is not helpful in deciding our question.

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[107]See Geyh and Schleicher, p. 232: "The main problem in applying this method to the dating of terrestrial samples is the lack of exact knowledge of the initial $^{234}U/^{238}U$ activity ratio, which is known only for marine samples." For marine samples, of course, a Flood might be expected to have had a major impact. And indeed there are evidences which could suggest that the initial $^{234}U/^{238}U$ activity ratio has varied. Ivanovich *et al.* in note 100 state on p. 410, "Furthermore, the $^{234}U/^{238}U$ activity ratios in modern marine shells are close to 1.15, the accepted value for oceanic water[3] [Kaufmann *et al.* in note 100], whereas the uranium isotope activity ratios in fossil shells are commonly greater than 1.15 indicating assimilation and uptake of uranium isotopes at least partly from sources other than oceanic waters[4,7]. [Veeh HH, Burnett WC: "Carbonate and phosphate sediments." In Ivanovich M, Harmon RS (eds): *Uranium Series Disequilibrium: Application to Enviornmmental Problems.* Oxford: Clarendon press, 1982, pp. 459-80; and Rosholt JN: "Open System model for uranium-series dating of Pleistocene samples." In: *Radioactive dating methods and Low-level counting,* Vienna: IAEA, 1967, pp. 299-311.]"

The dating of corals by the $^{234}U/^{238}U$ and $^{230}Th/^{234}U$ methods appears to be the place in radiometric dating where the data are most consistently supportive of the evolutionary hypothesis. There are still minor glitches, such as the occasional inconsistency with ^{14}C dates, but the evolutionary time scale does explain the vast majority of the published data with simple and plausible assumptions (but see Bar-Matthews M, Wasserburg GJ, Chen JH: "Diagenesis of fossil coral skeletons: Correlation between trace elements, textures, and $^{234}U/^{238}U$." *Geochim Cosmochim Acta* 1993;57:257-76). So it is only fair to ask for a creationist model that will perform as well.

A creationist model would have to start by saying that the $^{234}U/^{238}U$ ratio in seawater at the end of the Flood was close to 1.10, instead of the 1.15 ratio at present. With massive leaching of the continents and the input to the oceans of water with an average value of perhaps 1.5-4 (fairly typical of groundwater), the value of seawater would have risen fairly quickly to its present level and then moved little for the last several (4-20+ depending on the model) thousand years. The detrital content of the oceans, and therefore the thorium available for direct incorporation, would be decreasing during this time, giving decreasing $^{230}Th/^{234}U$ ratios and therefore decreasing "ages". Thus it seems that if thorium can be incorporated directly into corals (and this should be tested as it has

The ^{230}Th-excess method is used to date ocean sediments and manganese nodules. It is based on the theory that in present-day oceans uranium (including ^{238}U and ^{234}U) stays in solution for approximately 250,000 years,[108] whereas thorium is adsorbed onto plankton or sediment particles within decades. The excess thorium decays away by the equation

$$\ln ([^{230}Th_{excess}]_0 / [^{230}Th_{excess}]) = kt.$$

If the sediment is deposited at a constant rate, and the $[^{230}Th_{excess}]$ is constant, then

$$\ln [^{230}Th_{excess}] = \ln [^{230}Th_{excess}]_0 - kd/r,$$

where d is the depth and r is the sedimentation rate or the manganese nodule growth rate. Of course, the sedimentation rate and the thorium content of the oceans would be expected to have been greater in the past if a Flood occurred, making it difficult to make a straightforward interpretation of results. But an evolutionary interpretation is difficult also, as noted by Geyh and Schleicher:[109] "The application of this method to pelagic sediments has been successful [has given the expected dates] in only a few cases because A_0 [the initial excess thorium specific activity] apparently often changes with the rate of sedimentation . . .". "In manganese nodules, in addition to changes in A_0, ^{230}Th can migrate by diffusion . . . causing apparent ages that are too small by up to a factor of 3." So the ^{230}Th-excess method must be classified among

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been in bone; see Rae and Hedges in note 101), there is a simple creationist model which can also explain the data.

It is fascinating at this point to speculate concerning the two models. The creationist model suggests that Pleistocene corals near large land masses should be less reliable than mid-ocean corals, particularly having a ^{234}U/^{238}U ratio of greater than 1.15, while their ^{230}Th/^{234}U ratios should be higher than predicted by a straightforward evolutionary model. Furthermore, it suggests that there should be an unusual profile to pre-Flood corals. Their ^{234}U/^{238}U ratio should be less than 1.10, perhaps even approximating 1.00, which matches the evolutionary prediction of great apparent age, but their ^{230}Th content should be quite low, comparable with that of modern corals, giving ^{230}Th/^{234}U dates near zero. I have not yet run across any data in the literature which would appear to corroborate or refute these predictions. These predictions should be tested, but it is doubtful that any evolutionist would attempt to date paleozoic or mesozoic coral unless he considers a creationist model at least a possibility.

[108]Mean life? No supporting data are given by Geyh and Schleicher (p. 216).

[109]p. 236. An example of a sedimentary profile with a profile of excess ^{230}Th that is actually reversed can be found in Somayajulu BLK: "Analysis of the causes of variation of ^{10}Be in marine sediments." *Geochim Cosmochim Acta* 1977;41:909-13. No other evidence is cited for the hypothesis that this is a disturbed sediment.

the methods which do not aid in choosing between evolutionary and creationist time scales.

The ^{231}Pa-excess method is very similar to the ^{230}Th-excess method, and suffers from the additional drawback that ^{231}Pa is more soluble in water. It need not be further considered here.

The ^{230}Th-excess/^{232}Th method is similar to the ^{230}Th-excess method, but attempts to compensate for the variability of ^{230}Th concentration during sedimentation using the assumption that the input of ^{230}Th correlates "with the input of detrital ^{232}Th, which, of course, is not always the case."[110] For use in volcanic rocks, complete homogenization is assumed and an "isochron" plot is made. After the rubidium/strontium isochron discussion above we need not comment further. This method is not enough of an improvement to merit a change in our evaluation of the ^{230}Th-excess method.

The ^{231}Pa-excess/^{230}Th-excess method assumes that all the ^{230}Th excess and all the ^{231}Pa excess in ocean sediments came from precipitation out of seawater with ^{234}U, ^{235}U, and ^{238}U in present-day concentrations. The method is not as clear-cut as one might wish.[111] But more importantly, this method would be expected to have been drastically affected by detrital components of Flood waters.

The supported ^{226}Ra and unsupported ^{226}Ra methods are "only of historical significance with respect to . . . application for oceanographic studies."[112] The other applications seem to deal with recent dates and are not relevant to our discussion.

Of the dating methods which have been discussed, potassium/argon dating of basalts is slightly in favor of a short chronology, rubidium/strontium dating is against a long chronology, and the others are not much help in either direction, with the exception of uranium/lead dating, in which the data reported by Gentry *et al.* strongly support a creationist position. This leaves us with thermoluminescence dating and its relatives (optically stimulated luminescence and electron spin resonance dating), fission-track dating, pleochroic haloes, amino acid dating, obsidian hydration, and the cosmic ray nuclides to consider.

Thermoluminescence dating depends on the fact that natural crystals have tiny imperfections which can hold electrons. When

[110]Geyh and Schleicher, p. 238.

[111]Geyh and Schleicher, p. 240.

[112]Geyh and Schleicher, p. 243.

a crystal is irradiated, the radiation sometimes knocks electrons into these "holes". They then remain trapped until the material is heated, whereupon they jump back where they belong with the emission of a photon per electron. The method depends on knowing the dose of radiation (uranium, cosmic ray, potassium, etc.), the characteristics of the crystal, and the association of heating with the event to be dated (and no heating since). It is also technically demanding. Finally, there seems to be a plateau effect (when all the defects are filled with electrons, no further "aging" can occur), which would tend to blur the difference between an evolutionary and a creationist time scale. This method is primarily used in archaeology and is not much help with our problem. Interestingly, from an evolutionary standpoint, "the interrelation of the TL signals from meteorites in terms of radiation ages or terrestial ages has not yet been solved."[113] A creationist explanation of these data is perfectly straightforward.

Optically stimulated luminescence dating and *electron spin resonance dating* are simply two more ways to measure the displaced electrons that are measured by thermoluminescence dating. They give us no additional information at this time.[114]

Fission track dating is based on the spontaneous fission of ^{238}U. The constant for this decay is around 7 to 8 x 10^{-17}/year (there is some uncertainty in the measurements and more uncertainty in the method of measurement), which is much less than the alpha decay constant (most ^{238}U atoms decay by alpha decay). When a ^{238}U atom fissions, the two major fragments fly in opposite directions with enough force to disrupt the crystalline or polymeric structure over a track of about 10 to 20 microns. These tracks can be seen if the mineral is ground and polished, then etched with a chemical solution such as hydrofluoric acid or

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[113]Geyh and Schleicher, p. 270, citing Sears DWG, Hasan FA: "Thermoluminescence and Antarctic meteorites." In Annextad JO, Schultz L, Wänke H (eds): *International Workshop on Antarctic Meteorites*. LPI Tech Rep 86-01. Houston: Lunar and Planetary Institute, 1986, pp. 83-100. Sears and Hasan give Antarctic meteorite thermoluminescence values which are scattered over two orders of magnitude and are all within the range of values for modern (witnessed) meteorites. It is fascinating that the heat of entry into the earth's atmosphere is not supposed to reset the thermolumincence that the meteorites acquired from cosmic rays in space.

[114]It is of interest that electron spin resonance dating of the flowstone reported by Geyh and Hennig in note 103 was too high by up to an order of magnitude, especially in the recent material.

potassium hydroxide. It should then be simple to measure the ^{238}U concentration, count the tracks, and relate the two by a formula. But there are several complications.

First, it seems that ^{238}U is not always (in fact, is usually not) distributed uniformly in the crystal. In some cases starburst tracks can be seen apparently originating from ^{238}U nodules. Secondly, the volume in which a given number of fission tracks is located is hard to determine (it is easy to measure the area but not the effective depth). So a surrogate for the ^{238}U concentration is used which gets around both of these problems. With ^{238}U, ^{235}U is found in the standard ratio. The ^{235}U can be caused to fission by irradiation with neutrons (this neutron-induced fission is the principle behind the atomic bomb). This reaction produces independent fission tracks which can be compared with the ^{238}U fission tracks. With a relatively simple formula, the age can be determined from the two counts.[115]

But this approach is not without problems. The decay constant for the spontaneous fission of ^{238}U is uncertain, and makes the derived time imprecise. More importantly, the neutron flux is hard to determine, and varies from place to place in a reactor. So the preferred procedure at present is to compare the spontaneous and induced fission track densities on the sample rocks to those on several reference (monitor) rocks whose age is known. The age of the sample is found by $t = tm\ (\rho_{sf}/\rho_{if}) / (\rho_{msf}/\rho_{mif})$.[116] Of course, if the zeta correlation, as it is called, is used, it makes the age of the sample depend entirely on the age of the monitor. This means that fission tracks when interpreted this way give only relative dates.

In addition, there are problems with annealing (track fading). Often there are not enough visible tracks to match the presumed age. To correct for track fading, samples are heated and

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[115]The formula is $t = \ln(1+ \frac{\rho_{sf}}{k_{sf238}} k_{238}\sigma\phi_{235} \frac{^{235}U}{^{238}U} /(k_{238} + k_{sf238})$ where ρ is the density of fission tracks, k_{238} is the alpha decay constant of ^{238}U, $k_{sf\,238}$ is the decay constant for the spontaneous fission of ^{238}U, σ_{235} is the cross-section of ^{235}U for thermal neutrons (5.802×10^{-22} cm^2), and ϕ is the neutron flux in neutrons/cm^2.

[116]Where ρ is the track density, m is the monitor, sf is spontaneous fission, and if is induced fission. Strictly speaking, the formula given in Faure, p. 346, col. 1 (20.13 and 20.14) is more accurate.

the spontaneous to induced fission track ratio is measured for various temperatures (or the same temperature for various times). The induced tracks, and the spontaneous tracks that have not faded, begin fading promptly at a critical temperature. Tracks that have been partially annealed do not begin increased fading until a higher temperature is reached, so the spontaneous tracks reach a higher ratio to the induced tracks before starting to fade. This gives a plateau age which can be correlated with other radiometric ages (for example, potassium/argon ages).[117]

At first glance the agreement that was reported by Naeser *et al.* appears to be a powerful confirmation of both fission track dating and the dating method with which it was compared, and a good argument for plateau ages. This is particularly true when it is realized that fission tracks in some minerals can be demonstrated to be reset under geologically reasonable conditions.[118]

However, several considerations appear to have been overlooked. First, one may remember that the use of glasses in potassium/argon dating is discouraged. To use them here because the data obtained fit a particular theory is opportunistic unless such use is further justified. Second, Naeser *et al.* used a value for the ^{238}U spontaneous fission decay constant that was lower than the value found using determinations made on modern standards,[119] thus throwing off that beautiful correlation line by about 17%. And third, the precision of the method is only ± 10%, and even greater if the uranium distribution is not as uniform as expected. Frankly, the data in Geyh and Schleicher (following Naeser *et al.*) look too good for the precision of the method, raising the question of whether the data have been filtered. And it turns out that they have been. Naeser *et al.* in the original paper do not themselves believe that the data are as good as appears in Geyh and Schleicher's treatment.[120]

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[117]Geyh and Schleicher, p. 294, figure 6.96, citing data from Naeser CW, Izett GA, Obradovich JD: "Fission-track and K-Ar ages of natural glasses." *US Geol Surv Bull* 1980;1489:31.

[118]For example, see Storzer D, Wagner GA: "Correction of thermally lowered fission-track ages of tektites." *Earth Plan Sci Lett* 1969;5:463-8.

[119]Thiel K, Herr W: "The ^{238}U spontaneous fission decay constant redetermined by fission tracks." *Earth Plan Sci Lett* 1976;30:50-6. The error is about 17%.

[120]See Naeser *et al.*, note 117, p. 13: "It should be noted that this procedure does not always yield concordant results (McDougall [*sic*], 1976, and *this study*)." (citing MacDougall JD: "Fission-track annealing and correction procedures for oceanic basaltic glasses." *Earth Plan Sci Lett* 1976;30:19-26. Italics

Fission-track dating is not an easy way to date fossiliferous formations. Problems in the method are such that "the quality of the data is very dependent on the skillfulness and experience of the laboratory staff."[121] But even with a good laboratory, "The main disadvantage of the FT method is that the results are often difficult to interpret in terms of actual ages."[122]

Why does it take a skillful and experienced laboratory staff? The procedure itself is not hard. One simply irradiates half of a sample with neutrons (expensive but not technically difficult), mounts the samples on epoxy, then puts them in the appropriate reagent for a specified time. There can be up to 50% variation in the time needed in the reagent without significantly altering the results.

The problem is in identifying the tracks. Theoretically, if all the tracks were the same size and shape and there were no confusing structures, the job should be easy. But there are such structures.[123] And the very fact that some minerals have partially

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mine). I can find two glasses which did not give concordant dates that were left out of the graph. In addition, many more were not reported. See p. 3: "These natural glasses were chosen from a large group in our collection . . ." Other papers, such as Naeser CW, Fleischer RL: "Age of the apatite at Cerro Del Mercado, Mexico: A problem for fission track annealing corrections." *Geophys Res Lett* 1975;2:67-70, suggest that annealing does not always provide the answers expected.

Perhaps it would be worth quoting the abstract from Naeser and Fleischer (written 5 years after Naeser *et al.*, note 117):

> Fission-track dating and K-Ar dating indicate that the age of apatite from Cerro de Mercado, Mexico, is 30 m.y., in contradiction to previous corrected fission track ages of 40 and 57 m.y. by other works. Annealing data for the "plateau method" correction of fission-track ages for the Cerro de Mercado apatite lead to corrections by a factor of sixty or more, which give geologically unreasonable ages. In addition, published data concerning the length of fission tracks and the annealing of minerals imply that the basic assumptions used in an alternative procedure, the length-reduction-correction method, are also invalid for many crystal types and must be approached with caution unless individually justified for a particular mineral.

[121]Geyh and Schleicher, p. 287.

[122]Geyh and Schleicher, p. 293.

[123]For example, to finish the quote from Naeser *et al.* in note 120, "These natural glasses were chosen from a large group in our collection because they appear very fresh and because they are essentially free of microlites and crystallines, which can make fission-track dating impossible. Many obsidians are crowded with microlites and crystallines (gobulites and trichites), and these form fission-track-like etch pits following etching with hydrofluoric acid. The etch pits of the microlites and crystallines are difficult to separate from real fission tracks formed from the spontaneous decay of ^{238}U, and accordingly, calculated ages based on counts including the microlite and crystalline etch pits are not reliable."

annealed tracks says that the fission tracks themselves vary in length and width (older tracks should be more annealed than younger tracks).[124] The fission tracks do not come labeled as such. So it takes an experienced eye to pick them out. How do we know that the eye is experienced? Because it gives us the "right" dates. We again have circular reasoning, unless the data can be obtained by individuals who know nothing about the presumed age of the rock.

Even with the plateau correction technique, most fission track dates are too young, even for specimens that have remained (as far as we know) below room temperature over their entire history.[125] Inherited tracks are a concern in some minerals.[126] There is great need for more review, and for more data, particularly blinded data; with all observations fully reported.

Even if fission-track dating presents a major problem to evolutionary theory, a creationist should not feel comfortable about the results at this time. Fission-track dating is theoretically able to disprove a creationist time scale. And there are enough old dates to make a creationist uncomfortable. So we will look at the difficulties for a creationist in more detail.

In order to disprove a short chronology, several conditions must be fulfilled. First, the etching pits must be shown to be due to fission tracks and not to other imperfections (this will be difficult in glasses). Second, the mineral must be shown to have been either formed, or heated to a specified minimum temperature for a specified minimum time (so there are no inherited tracks), at or following the time of the dated event. Third, the deposition should be clearly correlated with the existence of life. Fourth, the dating

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[124]I have not run across any photographs of partially annealed tracks in geological materials in the literature. I am assuming that the annealed fission tracks are not all uniformly decreased in size, like the photograph in Storzer and Wagner (see note 118, p. 465). If they are 99+% the same size, the only model that will fit the data is that of accumulation of fission tracks without annealing followed by a relatively sudden heating episode <1% of the putative age ago. That is not usually a reasonable evolutionary model, and the fission tracks would actually be evidence against the evolutionary time scale in that case. Or perhaps these pits are not fission tracks at all, in which case they are totally irrelevant to our question. Perhaps only the normal-sized tracks should be counted, or perhaps the difficulties of separating fission tracks from other artifacts in glasses are so great that the method cannot give meaningful data.

[125]See MacDougall in note 120.

[126]See Gale in note 84.

must be absolute and not relative. The zeta correction technique is not adequate without a securely dated standard. (In addition, fission tracks from neutron-induced fission of ^{235}U must be negligible, although in the average granite this works out to $\approx 0.01\%$ of the ^{238}U tracks.) I have not had time to review all the literature, but I haven't yet seen the "smoking gun" proving a creationist time scale wrong. The literature should have a thorough review from this standpoint. Incidentally, it would be fascinating to date secondary minerals, perhaps such as aragonite in corals or calcite in brachiopods, or perhaps petrified trees, with the fission-track method.

Pleochroic haloes are fascinating from the standpoint of the age of the earth. They can be found in multiple minerals, but the easiest to use is biotite mica, because it can be easily split into thin flakes. Pleochroic haloes are formed by alpha particle damage, similar to fission fragment track damage. Since alpha particles have higher initial speeds and are less positively charged than fission fragments, they produce minimal track damage until they slow down near the end of their range. At this point they create maximum damage. Thus if one splits a crystal at the point of a uranium inclusion one finds rings around the inclusion which are lighter at the center and darker at the edge. These rings are darkened in proportion to the radiation damage. The diameter of a ring is proportional to the energy of the alpha particles producing the ring. Generally, more stable isotopes emit alpha particles of lower energy and thus make smaller rings, whereas more unstable isotopes emit alpha particles of higher energy and make larger rings. A mineral inclusion of uranium which has all the daughter products present will create a series of concentric rings, with a size characteristic of the mineral.

It would be easy to measure the discoloration of the rings around an inclusion, measure the discoloration of a known alpha dose,[127] measure the uranium and thorium content of the inclusion, and calculate the age. However, this method "is hardly used anymore because of the thermal instability of the haloes and the fact that very old samples often reach a saturation point . . . and

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[127]Or according to Faure (p.355) one can calibrate by "studying halos in other specimens of that mineral of known age." This would immediately involve us in circular reasoning unless the true age of the "known age" mineral was indeed known.

thus yield apparent ages that are too small. The intensity of the coloring may even decrease when saturation is exceeded." " . . . many geologically unacceptable results have been obtained with this method."[128] "This method has been abandoned in favor of the isotopic dating methods."[129]

But is it really that unreliable? Notice that the above results suggest a younger age than the "geologically" acceptable one. One straightforward interpretation would be that at least some pleochroic haloes support nearly contemporaneous formation of some igneous and metamorphic rock formations, much younger than usually assumed. Perhaps the data should be reviewed. It just might be compatible with a creationist time scale.[130]

Amino acid dating is based on the fact that all amino acids except glycine have an asymmetric carbon (threonine and isoleu-

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[128]Geyh and Schleicher, p. 299.

[129]Faure, p. 355.

[130]The literature on the subject is apparently not large, but mostly old and published in obscure journals. In addition, many of the dates are precambrian and do not bear directly on our question, such as those in Deutsch S, Kipfer P, Picciotto E: "Pleochroic haloes and the artificial coloration of biotites by α particles." *Nuov Cim*, series 10, 1957;6:796-810. Some of the literature does not give good geologic characterizations of the specimens (for example, Joly J: "Pleiochroic halos of various geological ages." *Proc Roy Soc London A* 1923;102:682-705, where the Devonian halo-containing rocks are identified simply as "Co. Carlow (Ballyellen) mica", without a word as to the geological enviornment, and similarly "Tertiary mica of the Mourne granite" on p. 695).

To falsify a creationist time scale, one would have to show that pleiochroic haloes were found in rocks which had either formed or been heated enough to erase the previous haloes at or after their association with fossils, and that the halos could be reliably dated to well beyond a reasonable creationist time frame. This is indeed theoretically possible. It appears that pleiochroic haloes can be erased in mica at 500-705° C (Holmes A: "The age of the earth." *Bull Nat Res Council (U.S.)* 1931;80:159-96, esp. p. 188). In addition, fossils such as petrified trees might produce haloes which would falsify the creationist time scale (the only evidence of this kind that I know of is in favor of the creationist time scale. See Gentry et *al.*, note 93).

Of course, any evolutionist who tries this will also have to deal with the published work on polonium haloes (conveniently collected in Gentry RV: *Creation's Tiny Mystery.* 3rd ed. Knoxville, TN: Earth Science Associates, 1992). There are no good mechanistic evolutionary explanations of polonium haloes. The argument that they must be from uranium decay products ignores the evidence from the "uranium-poor White Mountain (New Hampshire) granites" cited on p. 332-3 (reprinted from Gentry RV: "Response to 'Radioactive halos: Geologic concerns.'" *Creat Res Soc Quart* 1989;25:176-80). I don't imagine that any evolutionist relishes the job of making coherent sense of all the important data within standard evolutionary theory.

cine and the secondary amino acids hydroxyproline and hydroxylysine have two), which can come in either right-handed (D) or left-handed (L) forms (see chapter 2). These amino acids are all found in only one form (the L form) in living organisms (with rare exceptions like D-alanine in some microbial cell walls). These amino acids slowly transform from L to D forms (and back again) randomly. If the transformation constant is known, amino acids may be used like radioactive isotopes for dating.

The obvious disadvantage of this dating method is that several enviornmental influences such as acidity (pH) and temperature influence the transformation "constant". The influence of temperature is particularly striking. A 1° increase in temperature increases the "constant" by 25%.[131] Thus "constants" must be calibrated by other methods. "Ages that are not based on such site-specific calibrations can deviate by several orders of magnitude from the actual ones (Dungworth 1976)."[132] This inaccuracy is enough to blur the difference between the creationist and evolutionary time scales.

One of the apparently repeating phenomena noted in amino acid dating is the decreasing of the racemization "constant" in older specimens.[133] This is particularly interesting in view of the fact that a straightforward interpretation of the creationist time scale largely eliminates the crookedness of this curve. Several very "old" samples still have significant amounts of L-amino acids and are not in equilibrium. In fact, this trend toward smaller "constants" in "older" samples is true for the entire literature.[134]

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[131]Geyh and Schleicher, p. 350.

[132]Geyh and Schleicher, p. 350, citing Dungworth G: "Optical configuration and the racemisation of amino acids in sediments and in fossils—a review." *Chem Geol* 1976;17:135-53.

[133]For example, see Geyh and Schleicher, p. 347, fig. 8.2. Also see Dungworth in note 132. On p. 149 he states, "The results for modern bone and that of Aztec origin are in excellent agreement; 700 years age disparity disclose no noticeable difference in the magnitude of the rate constants. . . . In Mammoth bone there is a distinct decrease in the magnitude of the rate constant, while the much older deer and walrus bones, of Pleistocene age, display rate constants which are about one order of magnitude less than those in modern bone. The implication is that the rate of the racemisation reaction is decreasing with time." In fact, on p 140 he reports Jurassic (conventional age 180 million years) material which still has a considerable excess of L-form amino acids. This is quite surprising from an evolutionary perspective.

[134]See Brown RH: "Amino acid dating." *Origins* 1988;12:8-25, which gave an exhaustive survey of the available literature.

The decrease is almost linear. In fact, the decrease approaches asymptotic if the effect of more recent racemization is considered.[135] The chemistry behind this phenomenon is not easily understood when viewed from an evolutionary perspective. Deep (older) sediments would be expected to be hotter, not colder, than surface ones. However, a creationist explanation eliminates this problem. This would seem to indicate that a creationist time scale is more in accord with the amino acid data than an evolutionary one. But the uncertainties inherent in the method undermine its validity as an argument for anything.[136]

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[135]The problem has to do with the way of averaging. We usually average by adding the items and dividing by their number. If there are 2 objects, one being 3 meters high and one 5, their average is (3+5)/2, or 4 meters. But if you go 30 kilometers/hour for 90 kilometers and 90 kilometers/hour for 90 kilometers, your average speed is not 60 kilometers/hour but [(30x3)+90]/4 or 45 kilometers/hour. This is because you spend 3 hours traversing the 30 km/h stretch and only 1 hour on the 90 km/h stretch. In fact, there is a puzzle which says, "If you want to average 60 miles per hour over a 60 mile road and you spend the first 30 miles going 30 miles per hour, how fast do you have to travel the remaining 30 miles?" The answer is not 90 or 120 miles an hour, but at infinite speed. That is, you can't make it. You have already used up the hour during which you should have finished the 60 mile trip.

In the same way, if a racemization "constant" for a 3,000 year old sample is 6.93×10^{-4}/y, so that its "half life" is 1,000 years, and a racemization constant for a 4,000,000 year old sample is 6.93×10^{-7}/y so that its average "half life" is 1,000,000 years, the discrepancy is even greater than it appears. For if the enviornment of the 6 million year old sample was the same as that of the 3 thousand year old sample for the last 3000 years, then it had at least a two-stage history. In the last stage it lost 7/8 of its leftover unmatched L-amino acids over 3000 years, and in the first stage it lost 1/2 of its unmatched L-amino acids over an approximately 4,000,000 year period (3,997,000 to be exact), for a constant of 1.73×10^{-7}/y. So if one calculates the early "constants" for the older samples, they are even smaller, and in some cases vanish entirely! (a 20,000,000 year old sample and a 20,000 year old sample with the same D/L amino acid ratio in the same enviornment would imply a racemization constant of zero for all but the last 20,000 years, or else an erroneous time scale.)

[136]One of the problems with using amino acid racemization as a dating technique is that the racemization "constant" not only varies with temperature, acidity, etc., but also with the position of the amino acid residue within the peptide. In general, the residues on the end of peptides are easiest to racemize (have the highest "constants"). However, there are strange cases such as isoleucine which racemizes easiest inside the protein (Kriausakul N, Mitterer RM: "Isoleucine epimerization in peptides and proteins: Kinetic factors and application to fossil proteins." *Science* 1978;201:1011-4). Thus instead of a simple exponential relationship between racemization and time one has a complex curve, depending on how much of the protein has hydrolyzed. There are even cases of the apparent reversal of racemization (Kimber RWL, Griffin CV, Milnes

The obsidian hydration method is based on the idea that freshly broken obsidian hydrates at its surface at a rate that is completely dependent on the type of glass, the temperature, and the time.[137] Because the thickness of the hydration layer varies with the square root of time, older dates are inherently subject to more inaccuracy than younger dates. Also, pressure, water, and solutes must have *something* to do with the rate[138] because the experimental hydration rates are determined in a pressurized reaction vessel with deionized water. In actual application, "dating errors may occur when the obsidian artifact has been subjected to heat because this changes the rate of hydration. Moreover, erosion of the surface, which is difficult to detect, also leads to incorrect ages."[139] Note that erosion would produce too young ages (since it is difficult to detect, one can simply throw out young ages that one does not like simply by claiming that there was erosion). In fact, erosion turns into peeling at 40-50 microns, or less with mechanical or heat stress. So there is an absolute limit to the dating accuracy.

With these problems in the method, I do not know of any data that cannot be explained by either a creationist or an evolution-

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AR: "Amino acid racemization dating: Evidence of apparent reversal in aspartic acid racemization with time in shells of *Ostrea.*" *Geochim Cosmochim Acta* 1986;50:1159-61; Kimber RWL, Griffin CV: "Further evidence of the complexity of the racemization process in fossil shells with implications for amino acid racemization dating." *Geochim Cosmochim Acta* 1987;51:839-46), so that older specimens may look younger than younger specimens subjected to the same conditions. Specimens may also appear to age suddenly. Obviously, this makes the method as presently done incapable of proving anything, and even suggestions must be tentative.

In addition, it is possible that amino acids have a preferred chirality (handedness) at equilibrium when in the middle of a protein. In that case the equilibrium mixture may not be a 1:1 D to L ratio, but something greater or (more likely) less than this. Thus a significant excess of L-amino acids may not necessarily prove that the protein is less than some number of years old. The Jurassic amino acids cited in note 133 may not be younger than the 2 million year limit given by Kimber and Griffin (*ibid.*). This is why I have not given great weight to the above analysis.

[137]The equation used is $d^2 = Ate^{-E/RT}$, where d is the thickness of the layer, A is a frequency factor, E is the activation energy, R is the universal gas constant, and T is the "effective hydration" temperature.

[138]Contrary to the claim that "Moisture content and pH of the surrounding enviornment seem to have no influence." (Geyh and Schleicher, p. 362).

[139]Geyh and Schleicher, p. 366.

ist time scale. There are too many fudge factors. Obsidian hydration is not much help in determining the most likely time scale.

Now we come to our last group of dating methods, those involving radioactive isotopes produced by cosmic rays. They are ^{53}Mn, ^{36}Cl, ^{81}Kr, ^{129}I, $^{26}Al/^{10}Be$, and of course, ^{14}C. Of these, all but the last are of limited application. Carbon-14 dating deserves its own section, so we will start with ^{53}Mn.

The ^{53}Mn method is dependent on the constant production of Manganese-53 from iron by cosmic ray bombardment, almost exclusively in meteorites. After the meteorites reach the earth, the production of ^{53}Mn essentially ceases. It then decays with a half life of $3.7 \pm 0.6 \times 10^6$ years. Thus if one knows the initial activity and the activity now, one can calculate the time required. However, the initial activity is difficult to determine. If we knew that all meteorites were saturated with respect to the radioactivity induced by cosmic rays when they entered the atmosphere, we could guess at the terrestrial age of a given meteorite. But "cosmic ray ages" are obtained from meteorites also, which implies that at least some meteorites are not saturated with respect to ^{53}Mn. Thus a meteorite that appears to have an old terrestrial age may simply have a young cosmic ray age instead.

Another complication is the fact that what is measured is not absolute ^{53}Mn concentration, but the $^{53}Mn/^{55}Mn$ ratio. Suppose a meteorite started out with an inhomogeniety in the distribution of iron and manganese. Since the ^{53}Mn is mostly produced from iron, the $^{53}Mn/^{55}Mn$ ratio would vary with location. The theoretical uncertainties in the method are such that dating either meteorites or meteorite dust in ice cannot be done with confidence. And for dust dates the possible interference from ^{53}Mn-free manganese from volcanoes would have to be taken into account.

From a creationist point of view it would be interesting to try dating paleozoic and mesozoic meteorite fragments. This will never be done in a scientific community dominated by evolutionary theory, but could provide evidence for a young earth. But it would not provide incontrovertible evidence for creationism, because of the uncertainties noted above. I also do not know if the appropriate meteorites have been found.

The ^{36}Cl method is dependent on the production of ^{36}Cl from ^{36}Ar by a neutron-proton reaction, and to a lesser extent from ^{40}Ar by spallation, from ^{40}Ca, and from various potassium species. It is also produced underground by neutrons from ^{35}Cl. The half

life of ^{36}Cl is $3.01 \pm 0.04 \times 10^5$ years. Unlike ^{14}C, which is widely distributed, ^{36}Cl is concentrated at latitude 45° N and S. The $^{36}Cl/Cl$ ratio can vary by 6 orders of magnitude.[140] The uncertainties in initial levels of ^{36}Cl and the probability that such levels would have been disturbed by a Flood make the method unsuitable as evidence for or against a long chronology.

The ^{81}Kr method is dependent on the production of ^{81}Kr from Rb, Sr, and Zr in meteorites by spallation. Apparently, the supply of ^{81}Kr on earth is largely from meteorites. Its half life is 210,000 years. It is used primarily to date meteorites. Like ^{53}Mn, it is used to measure both cosmic ray ages and terrestrial ages, and the two are mutually exclusive (it is interesting that it is apparently not driven off by the heat produced by entering the earth's atmosphere). The method can be safely ignored in our discussion.

The ^{129}I method is dependent on the production of ^{129}I from ^{129}Xe by cosmic rays, and by uranium fission and muon bombardment of tellurium ores underground. Its half life is 15,700,000 years. It is used to find cosmic ray ages of meteorites and to date tellurium ores. The variables behind this clock and the difficulty being sure the clock is reset make the ^{129}I method of little use deciding our question.

The $^{26}Al/^{10}Be$ method is dependent on the production of the respective isotopes by cosmic rays, the former apparently from argon and to a lesser extent from silicon and stable aluminum, and the latter from nitrogen, oxygen, and carbon. The production rates of the two isotopes are assumed to be proportional to each other so that the difficulties caused by their uneven production around the world can be ignored (neither the ^{10}Be method nor the ^{26}Al method were considered more than experimental by Geyh and Schleicher).[141] The method is used for dating ice, sediments, coral, manganese nodules, and "oceanic particulate matter", although the assumptions behind the latter dates seem staggering to me. The assumption of equal deposition of ^{10}Be and ^{26}Al during and immediately after a Flood seems strained, so from a creationist standpoint the method would seem to lack validity. This method again seems not to offer much help in answering our question.

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[140]Geyh and Schleicher, p. 197.

[141]The possible accretion of ^{26}Al from cosmic dust, of concern to some earlier investigators (for example, Amin BS, Kharkar DP, Lal D: "Cosmogenic ^{10}Be and ^{26}Al in marine sediments." *Deep-Sea Res* 1966;13:805-24) is apparently ignored.

To summarize, potassium/argon dating of basalts is in favor of a short chronology. Other potassium/argon dates are easily explainable from a creationist perspective, except for evaporites where there are problems for both interpretations. On rubidium/strontium (and potassium/calcium) dating the evidence strongly favors the creationist time frame. The data on uranium/thorium/lead dating is moderately in favor of the creationist position; if one trusts the Gentry data it nearly excludes the evolutionary time scale. On the other hand, the evidence on fission track dating is slightly in favor of the evolutionary time scale, although not coercive. The other methods are simply not helpful enough, although some of them, such as amino acid dating, lean toward the creationist position. All this is true without altering the radioactive time constants.

This will come as a surprise to many. Many have not even considered creationism to be a valid scientific option, let alone the most scientifically defensible one. But there is an even bigger shock in store. The next dating method we will examine, carbon-14 dating, almost mathematically eliminates the evolutionary time scale and almost mandates some kind of creationist time scale. We will examine that evidence now.

Carbon-14 Dating

Carbon-14 dating is based on the production of ^{14}C in the atmosphere by cosmic rays interacting with ^{14}N (nitrogen).[142] The production rate is nearly constant at the present time. The ^{14}C produced is rapidly turned into $^{14}CO_2$, which mixes in with regular CO_2 to form (before modern industrial society) a $^{14}C/C$ ratio[143] of 1.2×10^{-12}. The mixing is very efficient; within 10 years

[142]Cosmic rays actually produce little or no ^{14}C directly. Rather they release neutrons which react with ^{14}N (nitrogen) to produce ^{14}C and ^{1}H. To a much lesser extent the neutrons react with ^{17}O (oxygen) to produce ^{14}C and ^{4}He, and with ^{13}C directly to produce ^{14}C. The only other natural process that produces ^{14}C (outside of meteorites) that I have seen considered in the literature is the reaction of high energy ^{4}He nuclei (alpha particles) with ^{11}B (boron) to produce ^{14}C and ^{1}H. This process is unusual even underground, and is practically nonexistent in the atmosphere because of the extremely small amount of boron there.

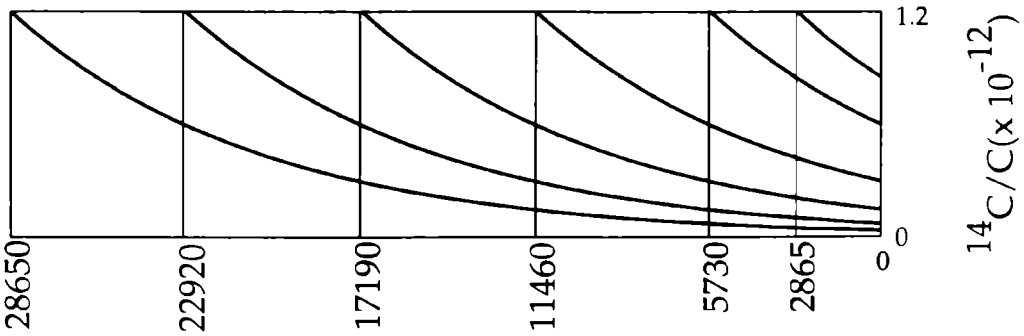
[143]For decay counting the ratio is usually given in decays per minute per gram of carbon, which relates directly to the $^{14}C/C$ ratio. This is why I have chosen to refer to the $^{14}C/C$ ratio in the text, even though this is not the precise ratio measured in all methods of radiocarbon dating. For decay counting, the $^{13}C/^{12}C$ ratio is also measured

of when atomic bomb tests doubled the amount of ^{14}C in the northern hemispheric atmosphere, it was thoroughly mixed throughout both hemispheric atmospheres.[144] The ^{14}C decays back into ^{14}N by beta decay, with a k of 1.21×10^{-4}/year, corresponding to a half life of 5730 ± 40 years.[145] The $^{14}C/C$ ratio in the biosphere (excluding the deep ocean regions) has remained nearly constant through the last few thousand years, thus providing the basis for measurement of the age of various carbon-containing substances. Since living things are made largely of carbon compounds and water, this method has the advantage of directly dating plant and animal remains.

Like the other methods we have considered, the ^{14}C method depends on assumptions. For ^{14}C dating, the assumptions are:

1. The decay constant of ^{14}C is invariant.
2. The $^{14}C/C$ ratio in the biosphere has remained constant.
3. The dated object was in equilibrium with the biosphere at time t_0.
4. The dated object has not gained any carbon since time t_0.
5. We can measure the present $^{14}C/C$ ratio in the object.

If these assumptions are correct, then $^{14}C/C = (^{14}C/C)_0 e^{-kt}$, and with a little calculus we get $t = \ln [(\ ^{14}C/C\ )_0 / (^{14}C/C)] / k$. Graphically the dating method can be represented by the following:



by mass spectrometry to correct for isotopic enrichment effects.

For accelerator dating the amounts of ^{14}C, ^{12}C, and ^{13}C are measured and the $^{14}C/^{12}C$ and $^{13}C/^{12}C$ ratios are calculated. These measurements can be used directly to calculate the radiocarbon age. The $^{14}C/C$ ratio determined by decay counting can be compared with the ratios obtained by accelerator dating straightforwardly: It essentially equals the $^{14}C/(^{12}C + ^{13}C)$ ratio, which is only about 1% higher than the $^{14}C/^{12}C$ ratio and is proportional to it to within the limits of the measurements.

[144]Levin I, Münnich KO, Weiss W: "The effects of anthropogenic CO_2 and ^{14}C sources on the distribution of ^{14}C in the atmosphere." *Radiocarbon* 1980;22:379-91.

To find a radiocarbon age, one measures the $^{14}C/C$ ratio in a sample, finds it on the right edge of the graph, and follows the (exponential) curve to the left until it intersects the "present" $^{14}C/C$ ratio in the biosphere. That point gives the radiocarbon age.

(If assumption 3 is valid, the specimen was in equilibrium with the biosphere, and if assumption 2 is valid, the biosphere had the same $^{14}C/C$ ratio that we find today when the specimen was last in equilibrium with the biosphere. Combining the two assumptions, the point at which we would expect to equal the present $^{14}C/C$ ratio is the point at which the specimen was last in equilibrium with the biosphere.)

Again we will assume (in fact, in this case insist on) the invariance of assumption 1. Assumptions 3 and 4 can be violated, but for our purposes we will assume that we have carefully chosen samples which were in equilibrium with the biosphere[146] and

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[145]When reading the literature one has to keep in mind that many references use a half life of 5568 years because of an old inaccurate measurement of the half life. To keep the literature consistent, "radiocarbon years" are usually given in terms of the older (shorter and less accurate) half life. We will follow this procedure here. There is only a 3% difference between the two half lives.

[146]There is a small isotope fractionation effect. One can compensate for this by measuring the $^{13}C/^{12}C$ ratio. The difference in $^{13}C/^{12}C$ ratio between one's sample and a standard is almost exactly half the correction needed for the $^{14}C/C$ ratio. This effect is rarely larger than 3% and is insignificant for our purposes.

Meteorite dating using ^{14}C is not directly comparable to conventional ^{14}C dating. In meteorite dating, the assumption is made that ^{14}C is made by cosmic rays at a constant rate in a given type of meteorite, and that this production essentially ceases when the meteorite lands on the earth. Thereafter the ^{14}C decays exponentially as does the ^{14}C used in conventional radiocarbon dating (see Sears and Hasan in note 113, and Kigoshi K, Matsuda E: "Radiocarbon dating of Yamato Meteorites." In Annexstad *et al.*, see note 113, pp. 58-60).

The ^{14}C found in meteorites is apparently largely produced by the interaction of fast (>10 Mev) neutrons with ^{16}O [^{16}O (n,2pn) ^{14}C], so stony meteorites, which have more oxygen, have higher concentrations of ^{14}C than iron meteorites. The amount of carbon in meteorites is variable, as is its ratio to oxygen, and so the $^{14}C/C$ ratio is useless in dating meteorites. What is used instead is the amount of ^{14}C per gram of meteorite.

Unfortunately, not all meteorites, even of the same general type, have the same concentration of ^{14}C. Some reports in the literature give the impression that the variation in ^{14}C concentration in recent falls is narrow. For example, Seuss and Wänke (Seuss HE, Wänke H: "Radiocarbon content and terrestrial age of twelve stony meteorites and one iron meteorite." *Geochim Cosmochim Acta* 1962;26:475-80) give a range of 37 to 56 decays per minute (dpm) per Kg of meteorite for their stony meteorites and 5.5 dpm/Kg for their iron meteorite.

have since not gained (loss does not matter) any carbon from their enviornment. It is usually fairly easy to satisfy these requirements.

Assumption 5 deserves some discussion. It turns out that initially it was difficult to measure the $^{14}C/C$ ratio in various samples. If carbon was measured as a solid, the total C was easy to measure; one simply weighed the carbon. But the ^{14}C was hard to measure; the beta decay of ^{14}C in solid carbon could occur in any direction, including into the rest of the sample or into the support, which meant that an uncertain and untestable factor had to be added into the equation. So decay counting is now done by using a carbon-containing gas like carbon dioxide, methane, or acetylene, or sometimes by liquid scintillation counting.

But gas decay counting and liquid scintillation counting have one major drawback; they detect not only ^{14}C decays, but also background radiation. And the background radiation is high, swamping the ^{14}C decays. Some of this background is from radon. The radon can be eliminated by allowing the sample to stand until essentially all the radon has decayed. Some background comes from neutrons, which can largely be absorbed by surrounding the chamber with paraffin and boric acid. But most of the background is produced by cosmic rays. One can shield against these by using steel and/or lead shielding. One can also ingnore them by the use of anticoincidence detectors.

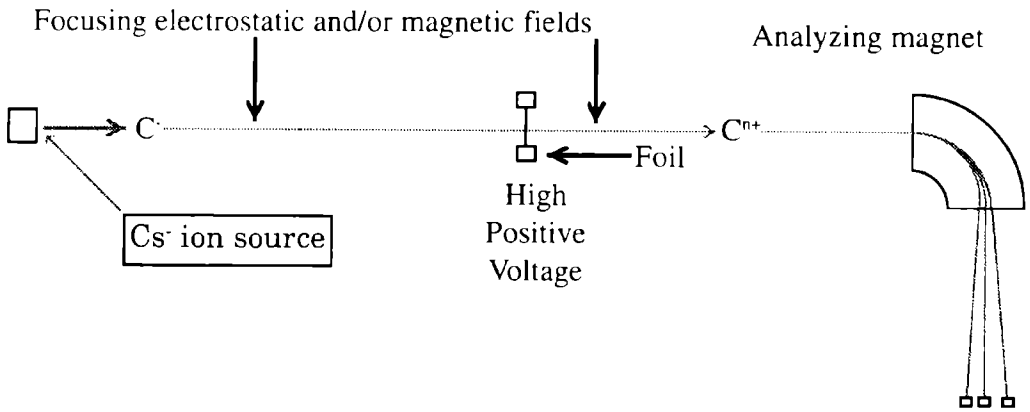
However, a different range is given in Goel and Kohman (Goel PS, Kohman TP: "Cosmogenic carbon-14 in meteorites and terrestrial ages of "finds" and craters." *Science* 1962;136:875-6), namely 47-78 dpm/Kg and 1.64-1.80 dpm/Kg respectively. Boeckl may describe the situation more accurately (Boeckl R: "Terrestrial age of nineteen stony meteorites derived from their radiocarbon content." *Nature* 1972;236:25-6). His range is 36-108 dpm/Kg for stony meteorites. This is quite a wide range and would give an uncertainty of approximately 9000 years in the calculated age of a find (a meteorite whose fall was not witnessed). It appears that meteorites, and even stony meteorites, have a wide range of ^{14}C concentrations when they fall. The range may be even wider than that given by Boeckl.

One is tempted to make the data more precise by measuring the $^{14}C/O$ ratio. However, according to Boeckl (p.25), "Finds usually show substantially higher oxygen values than falls, a fact which can be attributed to weathering." This would tend to decrease the ^{14}C/weight ratio, and to decrease the $^{14}C/O$ ratio even more. The ^{14}C dating of meteorites needs more study before it is helpful in our discussion. Its precision is not comparable to that of conventional ^{14}C dating.

In an anticoincidence system the sample counter is surrounded by other counters. If a cosmic ray hits the sample counter, chances are very good that it will hit one or more of the other counters at the same time. A computer can be told to ignore discharges that happen simultaneously in the sample counter and one or more of the other counters, and to count only discharges that occur in the sample counter alone.

Using these methods, one can get back to around 30,000 radiocarbon years, or about 1/40 of the present $^{14}C/C$ ratio (2.5 percent modern carbon or pmc). With special shielding deep underground and long counting periods it is possible to extend the range to 50,000 radiocarbon years (0.2 pmc).[147] Decay counting also requires about 5 to 10 grams of carbon, which may call for bone samples of as large as half a kilogram.

Thus there was considerable interest when it was discovered that ^{14}C ions could be separated from all confounding ions by a device called a tandem accelerator mass spectrometer, or AMS for short. The figure illustrates the operation of an AMS.



A beam of negative carbon ions is formed by negative cesium ions striking a carbon target. These ions may be partially separated according to mass by use of an analyzing magnet (not shown

[147]Some laboratories (for example, Grootes PM, Mook WG, Vogel JC, de Vries AE, Haring A, Kistemaker J: "Enrichment of radiocarbon for dating samples up to 75,000 years." *Z Naturforsch* 1975;30a:1-14, Grootes PM: "Carbon-14 time scale extended: Comparison of chronologies." *Science* 1978;200:11-5, and Stuiver M, Heusser CJ, Yang IC: "North American glacial history extended to 75,000 years ago." *Science* 1978;200:16-21) are apparently able to obtain dates in the neighborhood of 60,000 radiocarbon years without enrichment, and 75,000 radiocarbon years with isotopic enrichment techniques.

in the figure). They are then attracted to a positive electrode, where they are stripped of part (or all) of their electrons by either a foil or high-pressure gas. As positive ions they are then repelled from the electrode to very high velocities. These high energy ions are formed into a beam and sent through a magnetic field which separates them by their charge-to-mass ratio. A very specialized target is used for ^{14}C, which measures the amount of energy a given particle gives up traveling a definite distance through a semiconductor, and also measures the total energy of the particle. Sometimes the time of flight (and therefore the speed) of the particle is also measured. This gives a unique identification for ^{14}C. Cosmic rays, ^{14}N atoms, or other background factors should not be able to mimic ^{14}C atoms in this detection process. The prediction was repeatedly made that the machine background would be zero.[148] This made it theoretically possible to date very old samples, of the order of 100,000 radiocarbon years (0.0004 pmc). And at the same time it meant that the machine should be able to give dates on milligram-sized samples, as every decay per minute represents some 400 billion carbon atoms. The AMS method is also much faster (minutes versus hours of counting time) than the decay counting method.

The AMS development was particularly interesting from the creationist point of view. It made possible the testing of a creationist prediction that was incompatible with any evolutionist prediction, but which seemed mandatory from any creationist view except that of a gradually decreasing decay constant for radioactivity (which, as we have noted above, is nearly completely parasitic on evolutionary predictions). That prediction is that there should be measurable ^{14}C in all fossil carbon.

To understand the importance of this prediction we should

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[148]To be precise, the prediction was greater than 100,000 radiocarbon years range in Muller RA: "Radioisotope dating with a cyclotron." *Science* 1977;196:489-94; less than 1 count per run (50,000-60,000 radiocarbon years) in Nelson DE, Korteling RG, Scott WR: "Carbon-14: Direct detection at natural concentrations." *Science* 1977;198:507-8; less than 1 count per day in Doucas G, Garman EF, Hyder HRMcK, Sinclair D, Hedges REM, White NR: "Detection of ^{14}C using a small van de Graaff accelerator." *Nature* 1978;276:253-5; and greater than 70,000 years in Bennett CL, Beukens MR, Clover MR, Gove HE, Liebert RB, Litherland AE, Purser KH, Sondheim WE: "Radiocarbon dating using electrostatic accelerators: Negative ions provide the key." *Science* 1977;198:508-10. There were some objections, but these tended to be centered on the difficulty of preventing contamination of the samples.

first note that ^{14}C dating is arguably the most important dating method in establishing the evolutionary time scale. First, using a rather straightforward interpretation of ^{14}C ages, it gives dates that are compatible with the evolutionary time scale in the vast majority of cases. Second, it can be quantitatively tested on recent material and has passed that test repeatedly. So a creationist cannot simply disregard the method entirely (as is sometimes done for the potassium/argon method, for example). He or she has to explain why it works well for recent samples but not for older material.

A good creationist model for radiocarbon dating would seem to have to start by acknowledging that our assumptions 3-5 can be reasonably fulfilled in many kinds of organic material. Altering assumption 1 without a reason would seem to be an *ad hoc* solution and thus should be discouraged, at least at present. So we are left with alterations in assumption 2.

What could disturb the $^{14}C/C$ ratio in the biosphere? If one interferes with the transport of ^{14}C from where it is produced to the earth's surface, one will only decrease the amount of ^{14}C by the amount that decays on the way down, which in 100 years (a long time by meteorological standards) would be only about 10% with the most favorable assumptions (and probably closer to 1%), not nearly enough to account for the difference between the creationist and evolutionary time scales. One cannot vary the nitrogen content of the atmosphere much. Cosmic ray flux could conceivably be decreased by a stronger magnetic field on the earth, but the maximum reasonable effect would be only to drop the ^{14}C concentration by a factor of four,[149] and its actual effect would probably be less.

But increasing total carbon, the denominator of our ratio, has been demonstrated to give lowered $^{14}C/C$ ratios and falsely elevated ^{14}C dates. In the late 1800's, with the increasing use of fossil fuels, particularly coal, there was a marked ($\approx$5%) decrease in the $^{14}C/C$ ratio, which is called the Suess effect after its discoverer.[150] So an increase in the total carbon in the biosphere would

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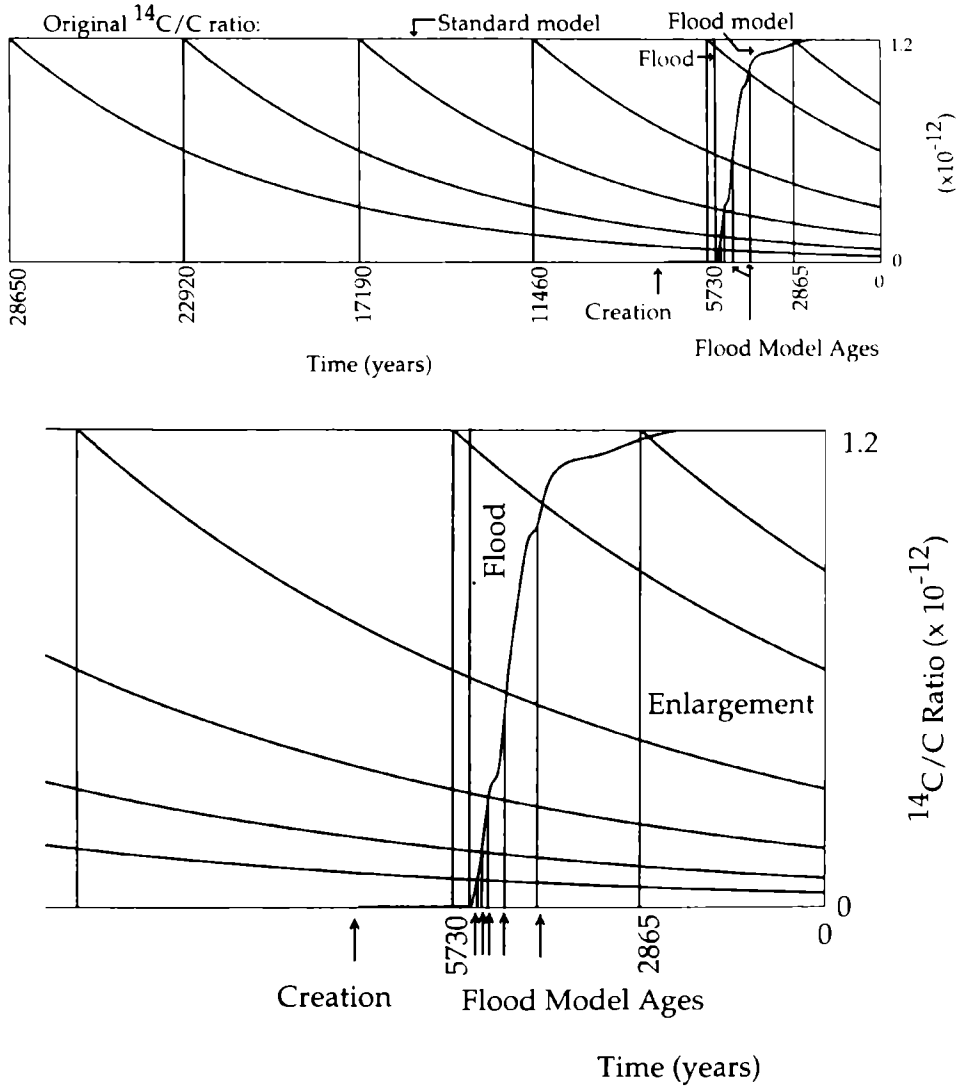
[149]Brown RH: "The interpretation of C-14 dates." *Origins* 1979;6:30-44.

[150]Suess HE: "Radiocarbon concentration in modern wood." *Science* 1955;122:415-7. This is the earliest reference I can find specifically measuring the effect we call the Seuss effect (The effect is hinted at in Seuss HE: "Natural radiocarbon measurements by acetyline counting." *Science* 1954:120:5-7 There is a reference in the *Science* articles to a "[H. E. Suess], Proc. Conf. on Nuclear

entail a corresponding decrease in the $^{14}C/C$ ratio.

And that is precisely what a creationist theory would postulate for the antediluvian (before the Flood) world. All the coal and oil, and some of the limestone, in the fossil record should have been in rough equilibrium with the carbon dioxide in the atmosphere. A standard estimate of this mass would indicate that the $^{14}C/C$ ratio, from this effect alone, would have been about



Processes in Geologic Set, Williams Bay, 1953" or "H. E. Suess, paper presented at the NSF Conference, Oct. 1953, Williams Bay, Wis.", which presumably predicts the existence of the effect. I have been unable to locate this paper yet). Because of the Suess effect, wood formed in 1850 was determined to be the reference standard for the $^{14}C/C$ ratio, rather than wood formed just before the first atomic bomb. This is true even though ^{14}C dates are customarily given in years BP (before present, present being defined as 1950).

1/200th of its present value.[151] So a model has been proposed in which the $^{14}C/C$ ratio was initially at about 0.1 to 0.5 pmc. According to this model, at the end of the Flood ^{14}C continued to be formed, but was now diluted in a much smaller pool of ordinary carbon, so that the $^{14}C/C$ ratio of the biosphere rapidly (and perhaps somewhat irregularly) rose, leveling off to near its present concentration within a few hundred years. Thus radiocarbon dates are not discarded, but are reinterpreted as shown in the above figure.

To find the age using this flood model, find the $^{14}C/C$ ratio at the right of the graph, follow the (exponential) curve to the left until it intersects the flood model $^{14}C/C$ ratio curve, then read the time from the scale on the bottom.

But this model implied that there should be residual ^{14}C in all antediluvian material. Specifically, if the Flood happened around 1 half life of ^{14}C ago,[152] the antediluvian $^{14}C/C$ ratio should be approximately 1/400 to 1/1600 the present ratio (0.25-0.0625 pmc).[153]

These measurements are out of range for all but the most careful, time-consuming, and expensive experiments using conventional decay counting. More importantly, with decay counting, it is necessary to measure background counts using a counter identical to the sample except for the absence of ^{14}C. This has usually been done by using fossil carbon, which is "known" to have had all its ^{14}C transformed to nitrogen. But if the question is whether this material still has ^{14}C, no amount of measuring could find ^{14}C by comparing fossil carbon with fossil carbon. Both

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[151]Brown RH, see note 149.

[152]A Septuagint date—the Masoretic Text would be slightly shorter (4,300 to 4,500 years or 0.8 half lives ago) and creationist theories which believe the Genesis 11 record is incomplete might have a Flood date as much as 2 to 3 half lives ago.

[153]The correction factor would be 1/200 for the ratio of antediluvian to postdiluvian biomass, 1 to 1/4 for the effect of the antediluvian magnetic field, and 1/2 for the passage of time. In point of fact, there is some uncertainty in the estimate of fossil carbon, so the factor of 1/200 might be better estimated at 1/100 to 1/400. There is also the theoretical possibility that the earth started out at the time of creation with no ^{14}C whatever, which would give an additional correction factor of down to 1/5 because of non-equilibrium conditions. This is doubtful even on creationist assumptions, since other radioactive minerals which naturally occur in living organisms (for example, ^{40}K) seem to have either been created or have maintained their identity through creation.

measurements would come out the same, almost by definition.

But when the AMS method was developed, there were repeated and theoretically persuasive arguments that the background could be essentially eliminated. So if there is ^{14}C in antediluvian material, it should be detectable with the AMS method. Thus we could have a clear-cut method to decide which time scale most accurately reflects the correct time scale for the history of life on the earth.

The earliest reports of measurements on "infinitely old" material were mixed. Several experiments on AMS gave backgrounds of 48,000 to 70,000 radiocarbon years.[154] But as time has continued, it has become general knowledge that there is a wall at about 50,000 radiocarbon years (about 0.2 pmc) that is not breached in practice. This is well within the limits of the creationist prediction, and outside the evolutionary prediction, or even of evolutionary theory.

The first evolutionist reaction to the data was to say that the machines were somehow giving background counts. This was unlikely theoretically, but possible. One should be able to test this possibility by dating carbon that had had practically all its ^{14}C removed, say, by mass spectrometry, and possibly also by

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[154]Some examples follow. Bennett CL, Beukens MR, Clover MR, ElmoreD, Gove HE, Kilius L, Litherland AE: "Radiocarbon dating with electrostatic accelerators: Dating of milligram samples of graphite." *Science* 1978;201:345-7, 48,000 years. Andrews HR, Ball GC, Brown RM, Burn N, Davies WG, Inahori Y, Milton JCD: "Radiocarbon dating experiments with the Chalk River MP tandem accelerator." In Gove HE (ed): *Proc 1st Conf on Radiocarbon Dating with Accelerators.* Rochester, NY: University of Rochester, 1978, pp. 114-26, 58,000 years (on "graphite"., with 2 counts. Dolomite had 5 counts, which would give it a calculated age of about 50,600 years). Litherland AE: "Radiocarbon dating with accelerators: Results from Rochester-Toronto-General Ionex Corporation." In Gove, *op. cit.*, pp.70-113, 65,000 years (on "graphite"). Bennett CL *et al.*, note 148, 70,000 years (on "petroleum-based graphite").

It is tempting to use the "petroleum-based graphite" of Bennett *et al.* as a measure of carbon from the antediluvian biosphere (from a flood model perspective) or from quite old carbon (from the evolutionary perspective). In this case one could argue that breaking the 50,000 radiocarbon year barrier mentioned below is a function of the form of carbon. However, while I have not been able to find out the geologic history of this particular carbon, I have been told by someone in the field that often graphite that is dated is simply bought from a supplier and the geologic history is not known by the experimenter. It is possible that this graphite was not in equilibrium with the biosphere at any time. Further observations and experiments could clarify this issue.

dating material which had not been in equilibrium with the biosphere near the time of the Flood. Two possible examples that came to mind were carbon from igneous rocks and precambrian carbon.

I had intended to test this possibility (and in fact had written to one AMS lab asking to arrange for experiments along that line) when I became aware that the most critical experiments had already been done by Schmidt *et al.*[155] They dated "geological graphite" to 69,030 radiocarbon years (0.0185 pmc). Prepared slightly less carefully, it dated at 58,590 to 65,840 radiocarbon years (0.028 to 0.068 pmc). Carbon-12 from the Faraday cup of the accelerator dated at 61,000 radiocarbon years (0.050 pmc).

At the same time, their anthracite coal dated "up to 52,000" radiocarbon years (0.154 pmc), and their marble ran up to 49,690 radiocarbon years (0.206 pmc). Thus, for antediluvian carbon they hit the same wall as other investigators, but they were able to go through this wall with graphite which may have represented carbon not in equilibrium with the antediluvian biosphere. Similar results were obtained with carbon from which ^{14}C had been mostly removed by isotope separation. Thus machine background is not an adequate explanation for more than 0.0185 pmc (radiocarbon age 69,000 years), and probably not for even that much (with the sample holder completely empty, their machine produced "≥90,000 years", or no counts in a 30 minute run).

With machine background eliminated as a reasonable explanation, there are only four ways I can think of to explain the background in anthracite coal and marble (and oil). It could be contamination during sample preparation, source contamination with modern carbon, *in situ* formation of ^{14}C, or residual activity.

Contamination during sample preparation seems unlikely to explain all the difference between most fossil carbon and the geologic graphite noted above. It should have affected the geologic graphite and the purified ^{12}C implant as well. And in order to explain the difference the samples would have to be consistently contaminated with a known contaminant (modern post-bomb carbon) at about 1 part in 1000. Anyone who did that would have flunked an analyti-

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[155]Schmidt FH, Balsley DR, Leach DD: "Early expectations of AMS: Greater ages and tiny fractions. One failure? - One success." *Nucl Instr and Meth* 1987;B29:97-9.

cal chemistry class. However, it is still possible that the experiments haven't been done carefully enough,[156] so one could simply take the "geological graphite" and subject it to the same process that the anthracite coal undergoes. If the dates are still different, then sample contamination may be ruled out.

Contamination of the source implies a worldwide exchange of carbon in all the world's known carbon deposits that is relatively even, in spite of the differences in the physical state of coal, oil, and natural gas. It also requires a roughly 50% exchange of the entire biosphere with fossil carbon, within the last 6000 years or so (the longer ago it happened, the greater the required degree of contamination). And again, the exchange rate is 0.2% of ancient carbon, which in a 1,000,000 barrel oil field is approximately 2,000 barrels, again within the past 6000 years. This amount of contamination is hard enough to believe with oil, and frankly incredible with coal.

In situ formation of ^{14}C would involve, in the easiest case, neutrons in massive quantities. There are strong arguments that "Subsurface production of radiocarbon is negligible (Zito et al. 1980; Florkowski et al. 1988)."[157] And if this were the case, one

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[156]There are two articles I know of that give data that suggest this as a possibility. First, in Grootes *et al.*, see note 147, it is noted that oxygen and nitrogen carrier gas apparently have enough carbon dioxide contamination to invalidate very old dates (compare their GrN 6553 with their GrN 6808). Their data are also difficult to interpret if one assumes that anthracite coal has a $^{14}C/C$ ratio of approximately 0.2 pmc; the data suggest rather that the ratio is >0.014 pmc. A repeat experiment to confirm these findings would be helpful. For some reason the method is little used nowadays.

Second, Beukins reports (Beukins RP: "Radiocarbon accelerator mass spectrometry: Background, precision and accuracy." In Taylor RE, Long A, Kra RS (eds): *Radiocarbon After Four Decades: An Interdisciplinary Perspective.* New York: Springer-Verlag, 1992) that the contamination in multiple samples from different sources was 0.076 to 0.081 pmc in the IsoTrace AMS. This, if reproducible, would seem to indicate that the major source of background in most AMS apparati is contamination during sample preparation. It would also suggest that the major source of background in the IsoTrace experiments was either residual activity or contamination at the reduction step. This differentiation should be subject to experimental determination.

[157]Geyh and Schleicher, p. 165, citing Zito R, Donahue DJ, Davis SN, Bentley HW, Fritz P: "Possible subsurface production of carbon-14." *Geophys Res Lett* 1980;7(4):235-8, and Florkowski T, Morawska L, Rozanski K: "Natural production of radionuclides in geological formations." *Nucl Geophys* 1988;2:1-14. Zito *et al.* calculated the production of ^{14}C in groundwater from neutrons. Using their best case (granite), the ^{14}C concentration would be 0.00266 pmc for an

might expect the effects to be variable on antediluvian material and to also affect "geological graphite" to a similar extent. *In situ* formation seems highly unlikely.

That leaves us with residual activity. But this mathematically eliminates the evolutionary time scale. For if we started with the entire earth's mass being ^{14}C, within 1 million years all of the ^{14}C would have decayed to ^{14}N except for 1 atom, and that one atom would have a roughly 99% chance of decaying. Each 5,730 years further back doubles the number of earths we would need to have that one atom, and we would need to have filled the universe before we get to 2 million years. The universe is demonstrably not made of ^{14}N. There is no way that 60-600 million-year-old material should have **any** residual ^{14}C, and thus if there is ^{14}C in this material which is not contamination, it is simply not that old. This evidence is in almost complete conflict with the evolutionary time scale. The phanerozoic is almost certainly less than 60,000 years old, and very probably 4 to 8 thousand years old.[158]

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apparent age of 87,100 years (5730 year half life). Florkowski *et al.* seconded their calculations. Redoing the calculations with oil (assuming no nitrogen and a density of 0.9 g/ml which will cancel eventually) and assuming a ^{13}C neutron cross section of 0.0014 barns (using the terminology of Zito *et al.*, $P = 3.89 \times 10^{-7}$ and N = 14,400 atoms of ^{14}C per liter of oil), yields 2.7×10^{-8} pmc, which is ridiculously low. It would almost take a neutron bomb to produce enough ^{14}C from neutrons to give the contamination presently found in phanerozoic carbon, and the neutron irradiation would have to be within the last 6000 years or so, or else most of the ^{14}C formed would decay to nitrogen before the measurement took place. Nitrogen is 110,000 times more efficient at producing ^{14}C from neutrons than carbon, so any production of ^{14}C from neutrons would be heavily influenced by the nitrogen content of the fossil material. I know of no such effect reported in ancient carbon. Perhaps it should be sought.

[158]I say "in almost complete conflict with" instead of "incompatible with" because it is still just possible that one of the other explanations for the presence of ^{14}C in paleozoic and mesozoic carbon is correct. Further experiments, as suggested above, to rule out or confirm these explanations should be done (and are being planned).

To summarize the experiments, they are: 1. to repeat the experiments of Schmidt *et al.* (see note 155), 2. to take carbon that dates older than fossil carbon (determined from experiment set 1) and run it through the same preparation procedures that are required for fossil carbon, 3. to determine the dates of fossil carbon from many different sources, and 4. to date fossil carbon of varying nitrogen content. If the fossil carbon from experiment sets 2-4 all has similar ^{14}C contents, which are significantly higher than that of our material found in experiment 1, then the evidence for a short history of life on the earth would be overwhelming. All the strata in the geologic column would be of roughly

This conclusion concerning ^{14}C dating is compatible with the weight of evidence for the other dating methods mentioned above, as well as a straightforward interpretation of the data on ^{10}Be (a "failed" dating method, that is, one which is not easily interpretable using the evolutionary time scale). Ocean floors show no consistent gradients of ^{10}Be concentrations,[159] which is more easily

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the same date, and it would be entirely reasonable (since they were almost all, if not all, formed under water) to attribute them to the Flood. If fossil carbon can be prepared with sufficient care (without significant isotope separation) that its ^{14}C content is <0.005 pmc, then this creationist model would be eliminated, leaving only the evolutionary model or a parasitic creationist model which assumes a change in the decay constant at the Flood (which at this point is not convincing). It is also possible that neither of these eventualities will happen, in which case one will simply have to take the best available data and make one's best guess. Given the relative ease with which the experiments should be able to be done, we should not have to settle for this, but it does appear that the evolutionary explanation for the data we have at present is by far the more strained.

The most likely date for the Flood, based on the present ^{14}C data, is one which would account for a present age of fifty thousand radiocarbon years in a biosphere with 200+ times the modern amount of carbon, which would require a Flood roughly 1 radiocarbon half life ago. I have given reasons why I do not trust the standard interpretation of the uranium series disequilibrium dating of corals, the only other consistent physical dating method to match (roughly) ^{14}C dates. Historical dates extend only 5,000 years back at best, and so are not a major problem for a short chronology. The only other major objection to a short chronology is tree ring dating. I have serious reservations about the accuracy of this method as usually applied. I plan to deal with tree ring dating more fully when I take up the subject of the Exodus, and I hope that currently unpublished material regarding the bristlecone pine chronology will be available at that time.

However, even if tree ring dating does turn out to be accurate as usually applied, it still would not solve the ^{14}C problem for an evolutionist. It would simply mean that Genesis 11 did not contain a complete chronology. The earth would still have to be much too young for any kind of evolutionary explanation to be adequate, and Genesis 1-9 would still contain the best available explanation for the fossil record.

[159]See the discussion in Faure, pp. 410-2. See esp. Inoue T, Tanaka S: "^{10}Be in marine sediments." *Earth Plan Sci Lett* 1976;29:155-60. On p. 155 Inoue and Tanaka stated, "The scarcity of cores having a uniform ^{10}Be concentration at different depths suggests that the sedimentation at the ocean floor has not been uniform but disturbed by some geophysical events in the past." It is of interest that wherever the data roughly matches an exponential curve, it is assumed that production and deposition of ^{10}Be and sedimentation rates have all been constant (Amin BS *et al.*, see note 141, although they also noted on p. 823 a "high frequency of cores with erratic ^{10}Be concentrations at different depths, even within depths of only one meter, suggest[ing] that the ocean floor is physically disturbed in many regions."), whereas later evidence indicates that, given the evolutionary time scale, production rates at least had varied (for example, Somayajulu, see note 109).

explained by a Flood than by very slow deposition of ocean sediments.

In addition, lava apparently formed from subducted ocean floors (which contain ^{10}Be from cosmic ray production) contains up to 7×10^6 atoms/g of ^{10}Be, whereas isolated volcanoes like Kilauea in Hawaii have 0.1×10^6 atoms/g of ^{10}Be. However, a basalt from the Columbia river plateau with an evolutionary age of 14 million years contained 1.0×10^6 atoms/g of ^{10}Be.[160] The half-life of ^{10}Be is 1.5 million years. If we assume that this lava started out with the highest known modern concentration of ^{10}Be, then only 0.01×10^6 atoms/g of ^{10}Be should have been left from the initial lava flow. Where the extra ^{10}Be came from is hard to say assuming the evolutionary time scale, but quite easy if the lava flow in question happened only a few thousand years ago. The existence of this ^{10}Be was predicted by Gentry in 1979 on the basis of a creationist model.[161]

If we are committed to following the weight of evidence we are led to discount theistic evolution and multiple creations as explanations of life on earth. We may also discount the (creationist) theory that decay constants have varied significantly with time, at least back to the Flood. And if it needed any further demonstration, mechanistic evolution is thoroughly discredited. Creationism may not have solved all its problems, but it has solved the major ones, and it is not unreasonable to believe that the rest will be solved with further study, whereas theories requiring millions of years for life (including theistic evolution and multiple creations) appear incapable in principle of solving the ^{14}C problem, and there is solid evidence that they are wrong in their interpretation of other dating methods.

This also means that we should give credence to the early Genesis record, and that we should seriously consider the claims

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[160]Faure, p. 415, citing Brown L, Klein J, Middleton R, Sacks IS, Tera F: "^{10}Be in island-arc volcanoes and implications for subduction." *Nature* 1982;299:718-20. On p. 718 they state that the phenomenon "certainly gives one pause." They try to explain this by the activity of cosmic rays. It would be interesting to test this theory by dating basalts from different depths. About 10 meters should be sufficient for testing purposes.

[161]Gentry RV: "Forum: Time: Measured responses." *EOS; Trans Am Geophys Union* 1979;60(22):474. He also predicted a $^{14}C/C$ ratio of approximately 0.01 pmc in paleozoic and mesozoic fossil material.

of Mosaic authorship, and also the accuracy of the rest of the Pentateuch and Joshua. I will not argue these points at this time. I hope to be able to do so later. For now I will assume that the entire Bible is reliable in the sense noted in chapter 3. I have now outlined, as a scientist might say, my materials and methods. Next, we will deal with some preliminary results.

6

God, Freedom, and Time

God is usually seen as all-powerful, infinitely wise, and present everywhere (the traditional phrase is omnipotent, omniscient, and omnipresent). For even from a Deist position, someone who could create life in all its complexity and arrange the galaxies, and who could order the intricate relationships within and among atoms, would have to be, if not infinitely powerful, at least more powerful than us by orders of magnitude. The Biblical view is certainly in agreement with this concept (*e. g.*, Acts 17:24-25; Rom 1:19,20).[1]

[1]This does not mean that God can do things which we cannot define and therefore call logically inconsistent. For example, one might say that God cannot create white darkness. Since we do not know what white darkness is, we would not know if God created it. There may not be any such thing. A tougher question is whether God can create a stone so heavy that He cannot lift it. But how would you know that it was that heavy unless He tried and could not lift it? And how would you know that He had really tried as hard as He could? Or if it did move, how would you know that it was the heaviest stone He could make? The question of the stone seems to hinge on whether God can do anything irreversible. He may or may not (He can't do something both irreversible and reversible in the same sense at the same time, for that would be logically inconsistent, or more accurately, we couldn't define it), but we would have no way of knowing. What we can say is that He chooses to do things which are not reversed.

And God must know a lot, even from a Deist perspective. Think of the intelligence required to fashion the rules of nuclear, atomic, and molecular interaction, and the further intelligence needed to make carbon compounds and water plentiful enough on this planet to sustain life, and the precise position of our orbit in relationship to the warmth of the sun, with a magnetic field shielding us from its more damaging rays, then the creation of life in its complexity. But the Biblical view goes even further. God not only knows about people (Ps 8:3-8), but unborn babies (Ps 139:13-6), sparrows, and the number of hairs on your head (Matt 10:29-31; Luke 12:6-7). If Jesus and his hearers had both been familiar with our concepts I am sure he would have said, "Not one atom leaves your body without My Father's knowledge." And, as we have seen while reviewing quantum theory, He would have been precisely correct.

Finally, God's presence everywhere may be deduced from the Bible (for example, Ps 139:7-10). Precisely what omnipresence is is not spelled out. One practical definition is that God is aware of everything that happens to everyone and can intervene if He sees fit. This would be a combination of the first two properties above. From the standpoint of scientific theology it makes no direct difference whether this is correct or whether God is actively moving all forms of energy according to His own laws. There is no testable way to distinguish between the two models, although the second is simpler and meshes more easily with quantum theory.

This view of God is a comfortable one, has elegance in the scientific sense, and has generally been accepted by Christian theologians. There we could let the matter rest, if it were not for one more property of God affirmed by the Bible, namely, His goodness (for example, Ps 107, Luke 18:19). This gives rise to the problem of why there is evil in the world if God is all-powerful, all-knowing, and wholly good.

There are several common ways to answer the question. We can say that we do not know enough to understand the answer to the question (sometimes a valid reply—see Job 38-41). We can say that God can do what He wants (which destroys any meaning to the word good as applied to God). We can say that evil has no reality (But the results of evil are certainly real. Rather than saying that evil is the absence of good, we would probably be more accurate to say that evil is twisted good). Finally, we can blame evil on another being. If that being is as powerful as God, then the fundamental

Judeo-Christian (and Moslem) tenet of one God is incorrect (and we may also have difficulty distinguishing which is evil on a theoretical basis). So evil apparently began with someone originally subordinate to God, who is now in rebellion.

Then why did God allow rebellion? One answer to this question is that God desired freedom for His creatures and gave them the power to choose. If they chose wrongly, evil would result. For God to run this risk He had to have a greater good in mind. This good is usually believed to be the ability of His creatures to love.

I agree with the general outlines of this approach. There are many good presentations of this answer, and I do not intend to add to them at this time. There are only two matters on which further comment is needed; freedom, and its relation to foreknowledge.

There are at least two kinds of freedom. One is the ability to do whatever we want, unhindered by outside forces. We could call this external freedom. The second is the ability to choose between two (or more) alternatives unforced by either external or internal factors. We could call this internal freedom.

A few general observations are in order. First, although they both could be thought of as freedom, they are very different. External freedom is a matter of degree. No one ever has complete external freedom. On the other hand, internal freedom is either there or not.[2] One can have a great deal of external freedom with no internal freedom, or one can have almost no external freedom and still have internal freedom. Finally, internal freedom is the

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[2]Can one have degrees of internal freedom? At this point we may not have a convincing answer to this question. This is partly because we do not have a good scientific model for internal freedom. Determinism is out by definition, but the model of random events is not much better. If God "plays dice with the universe", then how many throws do you get, and are the dice loaded? Does one chance in 1,000 qualify for a fair chance? One in a million? It could even be argued that if one knows the precise composition of the dice, their precise position and velocity, the precise force fields through which they moved, and the precise surface toward which they were thrown, that how they landed could be predicted, thus making that form of chance actually deterministic and not chance at all. Because we don't have a good model, we need to be very careful not to be too dogmatic about our knowledge of freedom.

We should also note that freedom is by the nature of things not provable by observation. For once the choice is exercised, it is final, and one could always look back and say that that is the way it would have turned out anyway. Freedom is sometimes defined as a choice that could go either way. But there is no way of backing up and trying again to prove that it really could go either way. Therefore from a scientific point of view it is not proveable. The closest we can come is to say that people in remarkably similar circumstances have turned out remarkably differently.

only kind that can relieve God from direct responsibility for creating evil. From this point on when we use the term freedom we will mean internal freedom unless otherwise specified.

As noted above, freedom allows for a solution to the problem of evil. But it also creates another problem. For God claims to know the future (Isa 46:10; compare Isa 65:24, John 6:64) and some prophecies seem to back Him up (for example, Daniel; some others are clearly conditional; see Jer 18:1-10, Jonah 4:2), and it is difficult to see how God can foresee free choice.

We can predict the future to a limited extent. Our predictions are made by noting repeatable patterns and extrapolating, or else they are based on our ability to cause future events by our own actions. God's ability to predict the future is no doubt based partly on similar premises, and since He knows everything that can be known and is able to do anything He wants (enough), it stands to reason that He should be able to predict the future much better than we.

But such ways of predicting would seem to prohibit freedom. For if God causes the event it is really His choice, not ours. And if He knows because we are locked into a repeatable pattern, then again the choice is not ours, but the creator or creators of the pattern. We would be controlled and not free.

Since much of human behavior is predictable, it follows that internal freedom is not something constantly possessed by humanity. This is a little disconcerting, as we would like to believe that we can choose to do right whenever we want. But one who is in the clutches of substance abuse demonstrates a lack of internal freedom, and we are constantly discovering new vices with the same iron grip, such as gambling, sexual excess, and child abuse. In all probability other sins such as pride are just addictive if not more so, and the only reason we don't have groups for them is that they are harder to define than, say, alcohol. (Even here we have a problem. How much alcohol does one have to drink before he or she has a problem?)

But we still have to deal with the question of whether (and if so how) God can predict the few truly free choices we do have. There are three answers I know of. First, there may not be any free choices. This would be the position of Calvin and (though he might protest) Luther. This view puts God back on the hook for causing all the evil we see in the world. Second is the view that God cannot predict free choice. Therefore He must make contin-

gency plans for all possibilities. This view is currently popular in certain theological circles. But it seems to be at odds with the Biblical claims. I would not rule it out completely at this point, but it is a solution with a certain amount of strain. The third solution has to do with God's relationship with time. I will try to outline this view and give some reasons.[3]

It is generally accepted that space presents no problem to God. He can be actively involved anywhere, and His control extends from galaxies to atoms. The usual explanation of this is that He is "outside" of space. That is, He is not limited by a body as we are.

In the same way it is generally accepted that God is over all time ("From everlasting to everlasting thou art God"). There never was a time that God did not exist, and there will never be a time when He will cease to exist. The usual explanation of this is that God is in time and experiences it as we do but simply started first and will outlast it. The view under discussion holds that God is "outside" of time in a similar way to the way in which He is "outside" space.

It is worth reviewing the fact that earlier in our history people believed that the earth was the center of the universe. Then it was moved to the sun, then to the center of our galaxy. It is sometimes said that there is no center to the universe, but actually by the theory of relativity it is more accurate to say that any point can function as the center.

But if God does not play favorites noticeably (and to add elegance to the theory, at all) with points in space, and Special Relativity is right, then God cannot be in time. For time and space are partly interchangeable.[4] To see why this is, we will conduct what Einstein would call a thought experiment. Theoretically, there is no reason why God cannot communicate across great distances in a fraction of a second. He can take a warning halfway around the globe, impress someone to pray, watch him pray, responding in internal freedom, and then use that prayer to influence far distant events. And in fact I, and perhaps you, have heard reasonably reliable stories to that effect. For example, a

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[3]I am heavily indebted to C. S. Lewis for the major outlines of this view, and through him to a number of older theologians. But the strength of the scientific reasons for it are not generally appreciated.

[4]So that for any two reference systems, $x_1^2 + y_1^2 + z_1^2 - t_1^2 = x_2^2 + y_2^2 + z_2^2 - t_2^2$.

mother in the U. S. during World War II is suddenly wakened in the middle of the night with a premonition of danger (the only time it happens). She looks at her clock and prays for her son on a ship in the South Pacific. At approximately that moment a torpedo which has been heading toward her son's boat swerves unexplainedly and misses it. She and her son later compare notes.

On earth this story is not intrinsically impossible given an omnipresent God. Light can pass from one end of the globe to another in about 0.04 seconds, so simultaneity is not an important consideration. But it takes 2 seconds for light to get to the moon, and if we send someone to Mars it may take light 5 to 21 minutes to get to our astronauts and the same time to get back again. For Jupiter it is 45 minutes (43 ± 8). Supposing the same scenario develops on a trip to Jupiter. The spacecraft suddenly gets into trouble. God wants (for His own reasons) a mother's intercessory prayer. How soon can He tell her? How soon can the results of her prayer be effective on board ship?

If we limit God to the speed of light, then two things follow. First, God is limited to $1\ ^1/_2$ hours turnaround time and He cannot act this way on problems requiring more rapid resolution. Second, God cannot communicate with Himself at greater than the speed of light, and at each point in the universe God is essentially cut off from every other point. You wind up with a multitude of independent calculators rather than one Mind controlling the universe. This would seem to be a species of pantheism rather than the monotheism of the Judeo-Christian tradition. And, as we have seen, quantum mechanics requires communication faster than light.

If we march God through time but allow message transmission faster than the speed of light, we create a new problem. For to an observer (perhaps an angel or a being on another world) moving rapidly in the direction from Jupiter to Earth (relative to Earth), it will appear that the solution to the astronaut's problem will happen before the mother on Earth prays, and to an observer moving rapidly in the direction from Earth to Jupiter, the mother is made aware of the problem before it happens. The only solutions are to deny that the problem could exist (to say that God never uses free choice in this manner), to limit God to the speed of light, to insist that God has a motion frame of His own, or to say that God is outside of time.

The first approach seems to me to beg the question. The sec-

ond approach has been proven wrong already. The third seems to ignore the lessons we have learned about God and space. It raises the question, what is really standing still? Is the earth standing still? Or the sun? Or the center of our galaxy? Or does God have some other galaxy which is the real reference point? In which case it will appear to *us* that the mother prays before the incident occurs, or that the resolution will occur before the mother prays (depending on whether Earth or Jupiter is in the lead). This is a mathematically possible solution, but a theoretically very unsatisfying one. In addition, quantum mechanics gives no hint of an absolute simultaneity.

But what do we mean by God being outside of time? We mean that God invented time as He invented space. God designed the universe very roughly analogous to the way that an author would design a novel or a moviemaker would design a movie, not only working with space but also with time. Now there are certain rules He must follow if He is to allow His characters true freedom of their own. He must be careful not to make predictions which overwhelm all free choice. He must allow free choice to have consequences (for example, He cannot take someone who has made an undesirable [to God] free choice and replace him with someone who appears to be the same but really has the memory of choosing rightly in that situation). And in that sense this model of free choice turns out to be identical in practice to God's deliberately choosing not to foreknow free choice. Thus the model of limited Divine foreknowledge has a great deal of truth to it. This is one consequence of time and space not being completely interchangeable.

But there are two important aspects of God's being outside of time which differ from the limited foreknowledge model. One is that God is able to go backward in time from a free choice and prepare for it, as long as His preparations do not directly impinge on the person's ability to choose. Thus, this model has no trouble (like the limited foreknowledge model has) with stories such as the one of the missionary's child who prays for a doll for Christmas and the next morning receives the doll in the mail, which was sent weeks before. The limited foreknowledge model must either postulate that the stories are not true, or that they are random, or that there is no free choice involved, or that some packages get lost in the mail on the day they are to be delivered.

The other important aspect of God's being outside of time is

that the final outcome of our story is assured. For after God had written our story He still had the choice of not publishing it, so to speak, so the fact that we are here is proof that the story has a happy ending, or God would never have brought our universe into existence.

Other things that are affected by this view are the relative importance of free choice and the physical universe, and the ultimate reality of that universe. Remember the old argument over whether a tree falling in a forest with no one to hear it makes any noise? In a sense this view would hold that until a creature with free choice hears it, the tree not only makes no noise, it can be said in a sense not to have fallen. Christians believe that the material universe is not the ultimate reality. But this view would have it that the material universe is not only dependent on God's creative ability but also on our own choices. We partly determine the physical reality of large objects. Perhaps we should have known all along that we are of much more value than many stars.

In this view also, we are allowed to pray about events that may have been in the past, or even were in the past. The exception is that for events which we know happened one way, we cannot pray for them to have happened another way and expect our prayers to be answered positively, as that is praying against the revealed will of God.[5] So the important dividing line is not between the past and the future, but between events that we know and events that we do not know.

I have heard two objections to this model. One is that we cannot deal with time in this way. This is tantamount to saying that relativity is wrong. One who takes this position must realize that this was the position of most of the world of physics. Physicists were forced to change their position by the overwhelming weight of evidence. It may help to note that the theory of relativity, although it predicts strange things happening with time, does not predict the reversal of time. The distortions are perfectly predictable. They are also usually very small and unnoticeable at everyday speeds and accelerations (a clock would lose less than one ten millionth of a second on a round trip transatlantic flight of a Concorde). In short, there is no reason why space and time should not behave as the theory of relativity predicts, and good evidence that they do.

[5]I am not saying that God is happy with everything that goes on here on Earth. But I am saying that nothing goes on without His permission, and that therefore every event that takes place is His will, given all previous and subsequent circumstances

The second objection is that a God outside of time is too much unlike us, too strange. But if the physics is right, then a God who must march through time with us is even stranger. For He has a private time frame but hasn't left us a clue as to what it is. It is actually much easier from a physicist's point of view to accept a God Who is outside of time in the same way that He is outside of space.[6] His major link to us is not time-limitation, any more than it is space-limitation. It is intelligence and creativity.

I would like to finish with two thoughts. First, the "Lamb slain from the foundation of the world" (Rev 13:8) makes much more sense according to this theory.[7] God knew what the cost would be when He first created the world. The plan of salvation was not an afterthought.

Second, if one can be sure on other grounds that a prophecy is from God, one may have confidence in it even if it involves the free choice of some humans. God will not prophesy so as to abolish freedom entirely, any more than He will force us completely in other ways, but He does have the ability to fore-see, to see into the future directly (not like us, who have to make projections), so we may have complete confidence if He says things will turn out a certain way

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[6]This does not mean that God cannot or does not act in time and space. It simply means that He is not limited by them.

[7]The RSV translation is strained here, as it transposes the phrase. The Greek is written as in the KJV

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The Trinity

A standard way to treat the trinity is to quote Matt 28:19, adding 2 Cor 13:14, perhaps adding Isa 6:3, Gen 1:1,2,26, Matt 3:16,17, and finally if one is naive, the KJV (following the Vulgate and a few late Greek manuscripts) of 1 John 5:7. This approach commonly finishes with three persons (meaning gods) who are all exactly equal (one substance) and who all work on the same team. It also leads to the (partly valid) charge by Moslems that Christians worship 3 gods and are not really monotheists.

It may be more helpful to start with monotheism, and follow the developments as they occurred. First, there was the Israelite experience, which left the Jews with the firm conviction that there was only one God, and to say otherwise was directly against His command (Ex 20:3). Nothing else was to be worshipped (Ex 20:4-6). The existence of other beings who might claim the title of god was acknowledged at first (Ps 82), but increasingly it was recognized that the idols worshipped by surrounding nations were no more than metal, wood, and stone (for example, Isa 40:18-26; 44:6-20, Jer 10:1-16, Hos 2:18-20). At the same time there was in-

creasing recognition of a supernatural power opposed to God (Job 1,2; 1 Chron 21:1; compare 2 Sam 24:1).

Then along came Jesus.[1] Early on some people recognized Him as the Messiah.[2] But He also called Himself the Son of Man,[3] which could be an allusion to Ezekiel (and Daniel 8:17) but more probably is to Daniel 7 where the Son of Man appears to be of the same order of magnitude as the Ancient of Days and receives worship (in fact, it is probably deliberately ambiguous—those with "eyes to see" will see in Him the figure of Daniel 7, whereas since Ezekiel used the term to describe himself, Jesus cannot be condemned for using it). He accepts the title "Son of God" (for example, Matt 14:33; 16:6; 26:63, Luke 22:70, John 1:49; 11:27; compare Matt 14:61) and even claimed the title Himself (John 10:36 and possibly 9:35-8). He accepted worship (Matt 14:33, John 9:38), something which neither other men (Acts 10:25-6) or angels (Rev 19:10; compare Col 2:18) would accept.[4] He forgives sin, something which supposedly God alone could do (Matt 9:2-7, Mark 2:1-12, Luke 5:17-26).[5] Finally there are the passages, characteristic of John but also found in the Synoptic Gospels (Matt 11:25-7, Luke 10:21-2), where Jesus refers to the Father and the Son, at one point at least clearly identifying the Father with God (John 8:54).

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[1]At this point I can hear some objecting that we cannot use the Gospel accounts in a straightforward way. But that is exactly what being an authoritative source means. The burden of evidence is on those who would deny the validity of that authority. And it is nonsensical to invoke a doctrine of no miracles as evidence against the authority of the Gospels in view of our previous discussion.

[2]The title Son of David (Matt 9:27; 12:23; 15:22; 20:30-1; 21:9,15, Mark 10:47, Luke 18:38-9) is also a Messianic title (Matt 22:42, Mark 12:35, Luke 20:41).

[3]In some circles it is fashionable to deny that Jesus used the title Son of Man. This is done on an artificial division of Matt 26:63-4 and Mark 14:61-2 (Luke gives a slightly different version), and Matt 10:23, Mark 8:38, and Luke 12:8-9, under pressure to separate Jesus from supernatural claims. But it must make major revisions to the Gospel story. It ignores the clear implications of several passages (for example, Matt 9:6; 20:18,28, Mark 2:10, Luke 9:22; 19:10, John 3:13-4; 5:27) and the direct identification in Matt 16:3.

[4]But the Son of Man would. See Dan 7:14. Some versions use the word "serve", but the Aramaic word used here is used exclusively of religious service in the Biblical record.

[5]But Matthew draws from it the lesson that God had delegated forgiveness of sins to men, presumably in general, in 9:7.

How does one deal with these facts? One can deny that Jesus knew what He was talking about. This is what the leaders of Judaism did, and the majority of the Jews apparently followed them. I find it hard to dismiss Jesus' claims that easily. Nobody back then, even of His enemies, disputed His miracle-working power; rather, they attributed it to the Devil (Matt 12:24, Mark 3:22, Luke 11:15). His raising of the dead can be passed off as initial mistaken diagnosis in most cases, but Lazarus was apparently starting to decompose (John 11, esp. v. 39). In some ways even more miraculous is the healing of the man born blind (John 9). If eyesight is not restored within a few years of birth, a blind baby loses the ability to have an appropriate response in the retina and/or brain to light stimulation, so that even if you replace the lens or cornea, the child remains blind. This means that Jesus could not have just repaired this man's corneae. He had to somehow rearrange the man's nervous system, and do so while leaving his sense of self and personality intact. Finally, if Jesus was not the Messiah, then the Jewish nation (and the world) is still waiting for the Messiah, as no one else of similar stature has appeared before or since. As John 7:31 puts it, "When the Messiah comes, shall he do greater works than this man?"

On the other hand, Jesus claimed to be one with the Father. This would seem to leave the option that Jesus was in some way to be identified with God. Jesus seems to have done that Himself when He said, "Before Abraham was, I AM" (John 8:58), "He who has seen me has seen the Father" (John 14:9), and "I and the Father are one" (John 10:30).[6]

Then on top of this we have the phenomenon of the Holy Spirit, which is spoken of in the singular. The early understanding of this seems to be that this is the same as the Spirit of God spoken of in the Old Testament, but in greater measure or able to do more qualitatively, or both. Thus the early church had to account for God the Father as ruler of the universe, Jesus Who was also God, and the Spirit inside of them Who was also the more or less direct influence of God. Some early formulas suggest that they had a Trinitarian view of all this (Matt 28:19, 2 Cor 3:17;13:14).

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[6]Although too much should not be made of the last statement because of Jesus' defense of it in vs. 34-38 and his statement in John 17:21-23 that we are to be one as Jesus and the Father are one.

This was the tack taken by the early Greek fathers. Their formula was one *hypostasis* (and later *ousia*), three *prosopa*. This is usually translated one substance, three persons (from the Latin *personna*),[7] but actually *prosopon* is better translated "face". The thought is three manifestations of the same God, although the manifestations are sufficiently distinct so that the Father suffered *along with* the Son at Calvary and not *in* Him.

It might be added that something like this theory would be required if God is outside of time and Jesus is in time. It is conceivable that God would have written Himself into the script, so to speak, when He created the world of time and space. But that would mean that although this Person would accurately reflect His character, this Person would not exhaust all there is to God. If this Person died (which Jesus did), the universe would not grind to a halt or fall apart.[8]

The popular misunderstanding of this has been that Jesus, God the Father, and the Holy Spirit are sort of like three players on the same team, each with His role. Each is a person, that is, a distinct being, but they all have the same substance, that is, each is (so to speak) made out of God-stuff. This is simply tritheism. In effect it is little different from Arianism, and in fact the problem of Arianism is not the making of Jesus subordinate to the Father (after all Jesus did use the terms Father and Son to describe that relationship, a clearly hierarchical one) but making Him a separate God. This does not do justice to monotheism.

One reason this is important is that it explains the central importance of the life of Jesus in Christian theology. If you really want to know what God is like, the clearest, most accurate picture of God is to be found not in nature or even in the Old Testament, but in Jesus of Nazareth. And that is not only true of His teachings, but also of his life. From a Christian perspective, which I believe we have seen to be the most reasonable, the life of Jesus is the most important set of events in history.

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[7]Interestingly, the Latin *personna* was a face or mask as well. It is the English translation which is distorted.

[8]This is not an easy concept to visualize. But that does not mean it is wrong. Quantum mechanics is difficult to understand. But it is still more correct than mechanical theories of matter. If there is another theory that is correct, then it is still stranger to our everyday experience. As C. S. Lewis observed, correct theology will be "at least as difficult as modern Physics, and for the same reason." (*Mere Christianity.* New York: The MacMillan Company, 1943 (10th printing 1958), p. 121).

Another reason this is important is that there are theories which involve driving a wedge between Jesus and God. Perhaps the best-known example is a common explanation of the substitutionary theory of the atonement. Briefly, this theory states that God has made a law that everyone who sins must die. We have all sinned, and therefore we must all die. But Jesus offered to die for us, and God has accepted Jesus' offer. So when our names come (or came) up in the judgment, and the Devil tries to point out our sins (some versions are base enough to make God "the accuser of the brethren"), Jesus pleads, "My blood, My blood," and God says, "Well, all right, I'll let this one in", or perhaps He can't even see our faults because He is too dazzled by Jesus' righteousness. Jesus really pulls the wool over God's eyes.

Now this model does explain some statements in the Bible. We have no room to boast about our own righteousness. There is some kind of judgment that goes on in heaven. And parts of the model do appear to have been used by the apostle Paul.

But it is not a perfect model. It is fundamentally flawed. For it pretends that Jesus is more interested in our welfare than God is, whereas the truth is that "**God** so loved the world that **he** gave his only son." (John 3:16) That is what the Trinity means. "He who has seen me has seen the Father." (John 14:9) God is every bit as interested in our welfare as Jesus is.[9]

What I am saying is that this view of the atonement is similar to Newton's law of Gravitation. Newton's theory explains a lot of things. It was once the best theory around. And it was rightly taught in physics books (and is still taught as an approximation). But it is not the way God thinks. This has partly to do with the exceptions, and partly to do with the fact that "simultaneous"

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[9]The theory that God can't see our sin because of Jesus' righteousness is also fundamentally flawed because God is omniscient. God sees not only the sparrow fall but also the boy whose slingshot made it fall. Indeed if the implications of quantum theory are correct, He made the nerve impulses go to his forearms, and the tendons transmit the tensions that allowed him to pull back on the slingshot and then let it go, and moved the rock toward the bird in response. The same holds true for murdering humans, or any other form of lawbreaking.

God is also responsible for keeping alive the memories of such deeds, as He is for all memories. Thus if anyone, including the "accuser of the brethren", remembers that something awful has been done, it is because of God. Thus God certainly does know how bad we have been. Perhaps the good news is that He loves us anyway.

cannot be defined in a straightforward manner (for those who want more information, the clearest explanations come from Einstein himself!). Similarly, this view of the atonement has good points. But it fails with the exceptions (which we will see later), and it makes assumptions which cannot be reconciled with trinitarianism, or for that matter, with the omniscience of God.

Thus, through a consideration of the relationship of Jesus to God the Father one can gain a new perspective on the way to ascertain God's character, understand more fully the relationship of God to time, and avoid buying completely into an imperfect theory of the atonement.

8

Sin

Sin is something that has been discussed in Christianity, and in Judaism before it, at great length. Jesus came, according to the angel (Matt 1:21), to "save his people from their sins." Jesus himself, according to several different Biblical authors, was without sin (John 8:46; 2 Cor 5:21; Heb 4:15; 1 Pet 2:22; to which we can perhaps add Isa 53:9). One might expect that the definition of sin would be easy.

But there is a great deal of argument over just what constitutes sin. Is it an action, an attitude, a nature, or some combination? If it is action, what actions are sin, and do motives play any part? We even have differences in the Bible, where Rom 8:28 states that "the wages of sin is death," whereas 1 John 5:16-7 speaks of a "sin which is not mortal." With the term "sin" being used in so many different ways, we cannot simply use the term without definition, so we will try to define sin first and then discuss it.

In defining sin, we must keep certain goals in mind. First, we want to have a recognizable definition; one that most people would be able to agree with. Second, it should be as faithful as possible

to the Biblical usages. Third, we should strive for clarity. There should be as few muddy edges as possible. Fourth, we should avoid definitions which try to define a particular theological view as truth. We should avoid compound definitions, which might be separable into their components. Rather, we should try to use a single definition. Then if we wish we may try to show that this definition is always compatible with another definition in our further discussion.

Sin as transgression

The first definition we will consider is that given in the KJV of 1 John 3:4, namely, "sin is the transgression of the law." Sin is literally *hamartia*, or not hitting the target—missing the mark.

This immediately involves us in difficulties. First, what is the target? What is the standard against which we are judged? Is it the law? If so, which law? Is it "everything that proceeds out of the mouth of the Lord."? That is one instinctive answer. But it has trouble with Jesus' apparent approval of David's eating the shewbread (Matt 12:3-4; Mark 2:25-6; Luke 6:3-4).[1]

It also has trouble because everything that is not ideal has not been made illegal. Jesus' comments on divorce indicate that even in the law of Moses ideal behavior was not always demanded. And laws are not only made more strict. Sometimes they are relaxed. See the changes in food laws from Gen 1:29 to Gen 3:18 to Gen 9:3-4. In fact, Jesus' scenario was that the divorce "law" was initially strict, then relaxed, then strict again.

Perhaps the standard is the ten commandments. They certainly are important. They are the only law that God wrote with His own finger. But they appear to be incomplete. For they say nothing about coveting someone's husband.[2] Perhaps they can be generalized. But the generalization will have to be extreme to take into account such statements as "whatever does not proceed

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[1]The story is found in 1 Sam 21:1-6, and the command in Lev 24:5-9. This view also has trouble dealing with conflicts of interest within the law (such as those cited by Jesus in Matt 12:5 where the priests perform work on the Sabbath, and John 7:22-3 where circumcision is performed on the Sabbath). However, this difficulty depends upon what is considered work on the Sabbath, and could possibly be resolved if the nature of the work that was forbidden on the Sabbath is clarified.

[2]It is reasonable to say that they were given in a sexist and polygamous society and reflect that situation in their precise wording.

from faith is sin."[3] In that case, we will need to have some guidance as to how we generalize. Breaking the 10 commandments may be sufficient to qualify as sin, but it does not appear to be necessary without considerable stretching. We will search elsewhere for a more complete definition.

Sin as lawlessness

The starting place for our second attempt comes from a retranslation of 1 John 3:4, namely, "sin is lawlessness." "Lawlessness" is a good translation of *anomia*. This appears to be an attitude, rather than a set of specific actions. So we may define sin as an attitude of lawlessness or rebellion. We could call this the state of sin. We should clarify the definition. The state of sin is not merely rebellion against anyone. If one rebelled against the Antichrist, one would not ordinarily be thought to have sinned. So let us say that the state of sin is rebellion against God.

But the Biblical and popular concept of sin also includes actions. The way to define sinful actions, or what we might call sins, that is most consistent with our definition of the state of sin, would be those actions which spring from, and give evidence of, a state of sin or rebellion against God. Until explicitly modified, we will use this definition in the following discussion.

What happens to the idea of sin as the transgression of God's law? I think that it is partly included in the above definition of sins. For what better, or more accurately, worse way to show rebellion against God than to deliberately disobey what He commands (that is, His law)? But we must be careful here. For which law are we talking about? If we are looking for a universal definition of sin, the law of Moses will not fill the bill. If we truly believed that all commands of God were universally valid, we would be obligated to build the Tabernacle again, re-institute the sacrificial service, and to stone adulterers and Sabbathbreakers. I don't think that is a live option if we believe Christ is God. The ten commandments? That is better as far as people are concerned. They are considerably more cross-cultural.

But the ten commandments fail when translated to heaven. For the Biblical testimony is that Lucifer sinned and became Satan

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[3]Rom 14:23. The same principle is illustrated in 1 Cor 8, where an action (eating meat offered to idols) which is wrong to someone with one set of beliefs is right for someone with another set of beliefs, but not if the first person is watching. It then becomes sin (v. 12).

(and was cast out of heaven). Lucifer was certainly in rebellion against God. It is impossible to believe that he did not commit sins. But the ten commandments do not apply strictly. Since Lucifer had no parents, he could not dishonor them. Since angels do not marry (Mark 12:25 and parallels), they cannot commit adultery. We have no evidence of private property in heaven, and there is no evidence that Lucifer attempted to steal in the usual meaning of the term. There is no record of his killing any angels in heaven (there was "war" according to Rev. 12:7, but that may not have involved immediate death). And unless his rebellion came after the creation of the earth, there was no Sabbath to keep. The law that Lucifer broke was not identical to the ten commandments, literally understood (the spirit of the law may be a different matter).

But there is a candidate law that does apply to angels, that Lucifer did break, and that is even more cross-cultural than the ten commandments. It is the two-commandment law given by Moses in Deut. 6:4-5 and Lev. 19:18 and quoted by Jesus as the center of the Law in Mark 12:29-31 and parallels. Supreme love to God, and love for those around us as we love ourselves, is actually a law controlling motives. Breaking that law would seem to be the state of sin as defined above.

It is interesting that the opposite of love is not usually thought of as sin but as selfishness. But perhaps (as has been suggested by others) selfishness is the root of all sin. In fact the original official line of the Devil may have been that the law of love was not necessary; that all that was needed was to allow everyone to follow what has been called enlightened self-interest.

I have heard this line argued very persuasively by someone who (not surprisingly) was a member of the Libertarian party. Basically, he said that it is obvious that pursuing only short-term goals is harmful in the end. That is, narrowly defined, or unenlightened, self-interest is not the best course of action. But if one takes long-term goals into account, one's actions can be motivated by self-interest and still be beneficial to others. Thus one doesn't steal, not because it is "wrong" or because it harms others, but because it does harm to oneself. If one is caught, the harm is obvious. If one is not caught, the temptation to steal again will be greater, and one is soon caught in a vicious circle and eventually caught anyway. In addition, others miss their property and may be tempted to steal in return, and one soon must take measures which would not have been necessary otherwise to protect one's own (and the stolen) property. Finally, one has to deal with the

psychological burden of not being completely open with others for fear they will discover the theft (which merges into guilt). Thus one who follows enlightened self-interest does not steal. Similar lines of reasoning could be followed for all of traditional morality.

There is something to be said for enlightenment. It is not always wise for a wife to bail her alcoholic husband out of trouble. In the short run it may seem both kinder and easier, but over the long haul it may delay his recognition of the problem and therefore his recovery. In this case enlightenment is good from both a selfish and from a loving point of view.

But I strongly suspect that selfishness leads intrinsically to unenlightenment, or more accurately, the ignoring of light. I have run into a number of people who realize the dangers of sexual promiscuity, for example, but who don't really care. One in particular was very angry that people with human immunodeficiency virus (HIV—the AIDS virus) were not required to be branded in some way. He thought perhaps that everyone should be tested for HIV, and those testing negative could be given cards which they could show to each other before having sex. Pointing out to him that HIV infection may take 3 to 6 months to show on our present antibody tests (or more, we are finding out now) didn't change his position. He was simply unwilling to consider the possibility of premarital chastity. This was true in spite of the fact that it didn't affect him personally at the time (he was married, and by his account faithful). He did not want to accept theoretical limits to his freedom, even if it might mean injury or death.

I suspect that for everyone, sometime in life, there comes a time when a choice must be made between doing something which puts others first and doing something which appears to reward self at the expense of others. One may say that the choice never really happens, but it certainly appears to happen. If one's orientation is to self, then one will fail the test. But if one's orientation is to others, then one will pass.

This view meshes well with Jesus' teaching. Jesus not only seconded the two great commandments, but he also gave us the golden rule (Matt 7:12), the new commandment (John 13:44), and the famous quote, "Whoever would save his life will lose it, and whoever loses his life for my sake, he will find it."[4] Jesus clearly thought the source of defilement came from within (Mark 7:14-23 = Matt 15:10,15-20).

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[4]Which is quoted in all 4 gospels in slightly varying form (Matt 10:39;16:25 [the above quotation]; Mark 8:35; Luke 9:24;17:33; John 12:25).

Jesus is not really giving us a new teaching here. He is amplifying a strand that runs through the Old Testament. It starts in Moses, where the two great commandments were given (and also the tenth commandment), and runs through Micah 6:6-8 (especially v. 8: "He has shown you, O man, what is good; and what does the Lord require of you but to do justice, and to love kindness, and to walk humbly with your God?"). There are related themes in Isa. 58:1-12 and Zech 7:1-10.

The apostle Paul picks up the theme again in Gal. 5:13-14 and in Rom. 13:8-10, and amplifies it in the "love chapter", 1 Cor. 13, and James continues it in 2:8. And of course there is the book of 1 John.

To summarize, the fundamental law of morality is the law of love, the law of active concern for the well-being of others, God supremely, and others at least as much as ourselves. The state of sin is the state of rebellion against this law, and choosing our own self-interest as we see it as the basic guide for our behavior. Sins are interactions of this basic attitude, and goals, and facts, or more accurately, perceptions of goals and facts. Thus one's reasoning for murder might go as follows:

1. It is good for this man to live and worse for him to die (perception of goal, and I might add, the common presumption).
2. This man will die if I give him digoxin.
3. If I give him digoxin, his death will not be attributed to me.
4. If he dies and I am not caught, I will get the money from his life insurance policy (all perceptions of fact).
5. I want the money more than I want the best good for this man (motive—state of sin).
6. Therefore I will give him digoxin (sinful act or sin).

From the point of view of this theory, it is basically irrelevant whether the digoxin kills the man, or merely slows his atrial fibrillation and keeps him alive, or he throws away the digoxin and someone else takes it and dies, or God works a miracle and changes it into some neutral substance or even a helpful one. And the legal profession agrees. They are all either murder or attempted murder.

A word should be said about the differentiation of goals and facts. Facts are the realm where science reigns supreme. What will happen if something is done can be determined with a fair degree of precision regardless of one's motives (although those with purer motives may be able to see more clearly). But goals cannot be determined by science alone. Ethics is not a branch of science. What is good cannot be determined solely on the basis of what is.

Some scientists have tried to get around this obvious weakness of scientism (the idea that science can explain everything) by saying that there is no such thing as absolute good. Good for any person is only what he or she likes. As supporting evidence, they point to varying ideas of good in various cultures.

But this theory is not a requirement of science. It is merely a necessary doctrine of scientism. Science can easily acknowledge the possibility of phenomena outside of its domain, which interact with phenomena inside its domain. On a theoretical level, the evidence is overwhelming that the origin of life lies outside the realm of science. The extant scientific "explanations" for the origin of life are so woefully inadequate that they make it highly unlikely that such an explanation, even only moderately improbable, will ever be found (see the discussion in chapter 2). We cannot reproduce the origin of life in the laboratory. Yet the interactions of life and non-living matter, and even the interactions within living organisms, follow clearly observable scientific laws.

For that matter, on a practical level, the behavior of individual humans cannot be reduced to laws at the present time. All our predictions are of a probabilistic nature, sort of like our predictions regarding individual atoms. Yet the enviornment around each individual human continues to obey the laws of science, and his or her interactions with it can be predicted once we make allowance for his or her mindset. So the existence of science is not jeopardized by acknowledging the existence of phenomena outside of its domain, practically or even theoretically.

And the fact that different cultures have different standards does not prove that there is no such thing as an absolute standard, any more than the fact that different cultures have had different values for π proves that there is no such number. People can see the truth more or less clearly depending on their background, and societies have similar constraints.

This implies, of course, that some societies are better than others, that is, closer to the ideal. Some may think that I am setting the stage for exalting American capitalist Christian society, and will object that all societies are morally equal. But first, I do not believe that American capitalism (which I believe is not basically Christian) is ideal, impossible to improve on, or even necessarily the best on the globe (on the other hand, the modifications which would help most are not communist ones). And second, one must be a moral monster to insist that our society is morally equal to that of Nazi Ger-

many *and* Stalinist Russia, and that there is no moral difference between Pol Pot and Prince Sihanouk.

It might be tempting to close the discussion here. Sin is rebellion, and sins are acts growing out of rebellion. So far we have a neat little package.

But there is another use of the term sin which we must consider. In Lev. 4:1-2 we read, "the Lord said to Moses, 'Say to the people of Israel, If anyone sins unwittingly in any of the things which the Lord has commanded not to be done, and does any one of them . . .'" This is a different concept from that of a sin as an outworking of rebellion, for it is unintentional. The Hebrew for "unwittingly" (*šᵉgagah*) is the same word used for someone who kills someone unintentionally in Numbers 35. It applies to, for example, someone who drops a stone on someone else without seeing him (Lev. 4:23), but does not apply to someone who hits or shoves anyone in anger and causes his death (vs. 16-21). Also in the parallel passage in Numbers 15, unintentional (*šᵉgagah*) sin (vs. 22-9) is contrasted with sin "with a high hand" *(bᵉyad ramah*; v.30).

Here we have sin without motive. It is clearly the act of doing something bad, without intending to. I see no amount of twisting that can reasonably make this definition fit with a basic definition of sin as motive.

We still have an ambiguity in this definition. What makes the actions bad? Is it that they break some rule? Or is it that they are inherently harmful? Or can we make the assumption that the rules always exactly coincide with the dividing line between harmful and beneficial actions?

There is a great deal of attractiveness in the position that harmful actions are always forbidden by the rules. It means that one does not have to choose between obeying the rules and doing good as the basic guideline for action. It also means that as long as one obeys the rules, one can make any choice one wants. It would also mean that all who have the proper sensitivity can make up the rules themselves (and it is tempting to add that if they do not make up the proper rules it is because they are not trying to avoid harmful actions).

But this approach is doomed to failure. First, not all harmful actions are against the rules. No rules before about the 19th century forbade smoking, which is definitely harmful. And Moses permitted divorce, which Jesus pointed out was harmful. Secondly, the rules cannot be taken uncritically. They change from time to time. At one point participation in the sacrificial system

was required. Later on, it was not.[5] I seriously doubt that anyone now believes in putting "tassels" with "a cord of blue" on the corners of all his or her clothes as prescribed in Numbers 15:37-40 (reinforced in Deut. 22:12). Very few people obey the rule about hybrid cattle or clothing of blended fabrics given in Leviticus 19:19 (reinforced in Deut. 22:9-11). Jesus indicated that stoning was not the will of God for all who committed adultery (for that matter, David was not stoned).

But if there is a difference between harmful acts and unlawful acts, which is sin? It is tempting to opt for harmful acts. But then what of acts which are harmful, but not known to be such until centuries later? For example, there is growing evidence that the best diet is a vegetarian one. How does this relate to animal sacrifices and eating the sacrificed meat? Would anyone nowadays who was trying to be health-conscious serve a "fatted calf"? Does that mean that Abraham (Gen. 18) or the father of the prodigal son (Luke 15) sinned when they served what they thought was the best they had? What about missionaries that deliberately expose themselves to various diseases and dangers? It would appear that acts that could cause harm is not a completely satisfactory definition of sin.

But neither is unlawful acts. For in multiple instances things that are done legally but with evil intent are condemned. One can start with the tenth commandment which condemns wishing to do evil. There is the story in Jeremiah 34 of the Jews releasing their slaves, then legally forcing them back into slavery the next day. This profaned God's name, and it is difficult to avoid calling this sin. And Jesus in the Sermon on the Mount (Matt. 5:17-48) made the same application of the Law to intents and motives.

On the other hand, Jesus apparently approved the conduct of David in eating the shewbread. It is possible to continue to insist on calling this behavior sin. But then it is not fair to insist that because we call it sin that God fundamentally disapproves of it.

And that, I think, is the real reason why the topic is pursued as avidly as it is in some circles. There is a conviction that the real problem with the world is "sin". In some circles it is thought that if we could just avoid "sin" we could be perfect, and maybe Jesus would be able to come the second time. On the other hand, maybe we can't stop sinning. Does that mean we shouldn't try?

Frankly, I do not have all the answers to such questions. A

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[5]Heb 13:10; Col 2:16,17. See Giem P: "SABBATŌN in Col 2:16." *Andrews University Seminary Studies* 1981;19:195-210.

scientific theology would not require one to do so at the outset. It will ask one to attempt to clarify the issues involved. It will also require one to acknowledge any uncertainties involved, and to acknowledge the effect that these uncertainties may have on the further development of a systematic theology. It will also encourage one to propose models while knowing that they are almost certain not to be completely correct, and possibly to be primarily in error. Towards that end, I will propose the following tentative model.

A Three-part Theory of Sin

It appears to me that the Biblical data can be accounted for if three different definitions of sin are used. These definitions are interrelated but not identical. First, sin can be thought of as rebellious motive. Second, sin can be thought of as harmful action. Third, sin can be thought of as addiction.

It seems to me that God is primarily concerned with what has been traditionally called the heart.[6] Jesus made this very clear. In Mark 7:17-23 (= Matt. 15:16-20) He specifically stated that what comes from the outside does not defile a human, but rather what comes from the inside. His conversation with Nicodemus (John 3) was aimed at inward, not outward righteousness. In Matt. 12:33-7 (= Luke 6:43-5) Jesus makes it plain that the evil that people do comes primarily from the inside. In Matt. 23:25 (= Luke 11:39) Jesus condemns those who keep clear from ceremonial uncleanness but are full of sin and wickedness. In Matt. 5:28 Jesus notes that adulterous intentions are in the same category as adulterous actions. And in John 4:23-4 Jesus notes that the kind of worship God desires is "in spirit and truth", not confined to a physical place.

This emphasis is continued by the rest of the New Testament. Romans 2:29 speaks of being a Jew inwardly, and circumcision of the heart. But there is also a similar theme running through the Old Testament. Joel 2:23 speaks of rending the heart and not the garments. And Deuteronomy 30:6 also refers to circumcision of the heart. So any account of sin must take motives into account.

But at the same time it does make some difference what one does. Matt. 21:28-32 tells of one son who said he would help his father and didn't, and another son who at first said he would not

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[6]Notice the difference in attitude between unintentional sin and defiant sin in Num. 15:22-31.

go and then changed his mind and did. As has been said before, actions speak louder than words. For much of our lives, what we think determines what we do. And so we may catch some insight into what we really value by studying our actions (we may also catch some insight into what others think by their actions).

In addition, actions reinforce belief. Jesus recognized this when He said (Matt. 6:21), "Where your treasure is, there will your heart be also." I do not know whether actions can *cause* belief, or for that matter unbelief (there are theological grounds for denying it), but certainly acting on one's belief or unbelief tends to strengthen it.

Finally, certain beliefs nearly demand action. Belief in the harmfulness of tobacco, or the goodness of physical exercise, takes very few accompanying beliefs to determine a course of action. The belief that truth is important will cause one to seek it avidly. The belief that Jesus is God revealed in human form will cause us, with only the accompanying belief that God is honest and the commitment to truth, to try to find out what Jesus said and to listen closely to it.

Thus while it may be true that our fundamental attitude of love or selfishness is the really important differentiation, it does not follow that we will be unconcerned about actions. If anything, our concern about actions will be heightened, as the attitude of love is that which wills the most good possible for the object(s) of its love. That gets us into what is really good for our fellow humans. We are now dealing with sins as harmful actions.

We obviously do not know experimentally the complete answer to what sins (as harmful actions) are. Experiments can correlate some actions in a given set of situations with some outcomes. I as a physician would not wish to belittle the value of such information. Some ends seem on the face of it to be desirable, such as personal pleasure and happiness. Suffering in general would seem to be something to be avoided.

But as we are trying to determine the most helpful and least harmful actions, there are several caveats to be observed. First, long-term and subtle effects must constantly be kept in mind. We do not always know what the long-term effects of an action are. For most people, smoking did not become something to avoid on moral grounds until quite recently in our civilization's history. It took centuries to find out its ill effects on the smoker, let alone on the surrounding people. There may be many other actions which are harmful but concerning which our knowledge is at the same state as it was for tobacco 150 years ago (or even 50 years ago for

most of us). In addition, an allowance must be made for subtle effects. For example, there is a physiologic reaction when a normal person tells a lie. This is the basis of lie detector tests.[7] The means is automatically part of the end, and sometimes the only part over which we have direct control. A "calculus of love" must always be very humble about our knowledge of long-term and subtle effects.

Second, there is the problem of denial. The evidence for an action's harm can be consciously or unconsciously buried by an uneasy conscience. The alcoholic may easily deny (or rather, characteristically denies) that his/her habit does any harm. His/her statements should not be taken at face value.[8]

Third, one must not leave out the spiritual dimension (which is always a temptation in our secular age). This has several implications. One regards purpose. Man does not live by bread alone. If one loses one's purpose in life, and nothing takes its place, one's life beyond that time is literally pointless. There are some convictions worth dying for. Hedonistic pleasure alone, without purpose, eventually fails to satisfy.

There are implications of the spiritual dimension for time. If there is anything Jesus' resurrection suggests, it is that we may also look forward to life after death. And it is at least possible that others' eternal destiny may be influenced by our actions. If so, we will never be able to prove that an action was good based on its temporal consequences. We need to be even more humble about our unaided ability to judge.

This has implications for the relative importance of people and institutions. We often think of institutions as bigger, and therefore more important, than people. One needs to be very cautious about such judgments. If by institutions we mean collections of people, this may be true. But if we mean organizational structures, we need to recognize that institutions are all tempo-

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[7]One may argue that some people, namely those with a sociopathic personality disorder, may lie with impunity, but no ethicist worth the label would advocate being like them.

[8]The perceptive reader will note my heavy use of various addictions as models for sins. This is primarily because almost everyone can agree that at least the worst addictions are harmful, and therefore they may be used without getting into arguments over whether premarital sex, or capital punishment, or voting Republican (or voting at all), or other controversial areas, are sins. But also it is because some addictions illustrate points which are less obvious with other harmful actions, but no less true. In fact, it may turn out that all sins are addicting.

rary, whereas people are at least potentially eternal. Thus supporting an institution by hurting specific people is risky if not inadvisable.

There are implications of the spiritual dimension for methods. There is the authority of Jesus, abundant (although admittedly flawed) anecdotal evidence, and one double-blind controlled study[9] to suggest that prayer can change things somehow. Perhaps sometimes the proper thing to do is not to **do** anything, but rather to pray.

Fourth, if one is trying to avoid harmful actions, one must be sure that in a given case all relevant alternatives have been identified before one makes a decision between them. This is exemplified by Jesus' reaction to the temple tax question (Matt. 17:24-7). The obvious choices were 1. pay the tax and tacitly admit that Jesus did not have the authority as the Messiah that He claimed, and 2. not pay the tax and give the authorities an excuse to accuse Him of disloyalty. After Peter had made his reply, the second alternative also involved embarrassing Peter. Jesus pointed out a third alternative, namely, pay the tax in such a way that it was obvious that He did have the authority He claimed, while giving no technical grounds for the authorities to complain. Perhaps we should search for more viable alternatives more often, especially when the existing alternatives are unsatisfactory.

Fifth, we have no theoretical basis for insisting that there are no valid rules besides love.[10] Certainly in practice this position is highly unlikely. For example, one could specify a set of circumstances that in the entire sweep of human history would recur, say, 20 times. Then one of two conditions follow. Either there is no right (or perhaps rather, "best") action at any time, which seems highly doubtful,[11] or there is. If there is, then for each situation within this group there is a right choice and one or more wrong choices. It seems highly unlikely that for *every* such subset, regardless of how restrictive the circumstances, there is never *any*

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[9]Byrd RC: Positive Therapeutic Effects of Intercessory Prayer in a Coronary Care Unit Population. *South Med J* 81[7]:826-9, 1988.

[10]As has been done repeatedly by Joseph Fletcher in *Situation Ethics* (Philadelphia: The Westminster Press, 1966).

[11]It would imply that the God of precise rules in the "natural" world was a God of complete disorder in the moral sphere, and even situationists, or at least Fletcher, actually do not believe it. See *Ibid.*, pp. 24-26, and p. 104 where he condemns John Kaspar's actions, implying that a better course of action was open to him. See also Fletcher J: "Reflection and reply." In Cox H (ed): *The Situation Ethics Debate.* Philadelphia: Westminster Press, 1968, pp. 249-64, esp. pp. 256-7.

valid generalization that will be true for all such decisions. For example, how about the rule, "Between 1945 and 1992, the American President should not use nuclear weapons in a pre-emptive first strike against the Soviet Union." If you don't like that one, try reversing the roles of the U.S. and the U.S.S.R. Frankly, I am not terribly interested in hypothetical cases. God may or may not permit these cases to become reality. But in real situations, there are at least in some classes of situations general rules which are 100% valid, and capable of guiding behavior into the most helpful way, that is, the way that maximizes good and minimizes evil, in every situation for which the rule's preconditions are met.

Ethics can be likened to mathematics. One can start with a very few axioms, and then can build an incredibly complicated situation. But there are middle rules which are valid as long as their preconditions are fulfilled. As in mathematics, we can make mistakes (even "honest mistakes"). But there are correct answers whether we know them or not, and they follow rules as well.

Thus the second proposition of situation ethics, "The ruling norm of Christian decision is love: nothing else",[12] can only be true if one allows derivative norms (perhaps limited, perhaps always recognized as derivative) to be formulable at least in theory. And the sixth proposition, "Love's decisions are made situationally, not prescriptively", [13] is wrong. Some decisions can be made prescriptively. I would be afraid to visit a doctor who, although loving, made all his decisions situationally and never prescriptively; who did not have routines which he used on all cases which fell within certain limits. In fact, I would doubt that doctor's love. For love requires us to try to find out what is good and then practice it, and the only justification for not having such rules is that either there are none (which is nonsense—witness the success of science) or that we don't know them. And make no mistake. Medical practice rules are intended to be moral in the strictest sense.

Sixth, since there are rules, and God knows all the rules, it is certainly possible that He could reveal them.[14] So we do well to pay attention to the rules that claim revelation as their authority, and if the claim is reasonably convincing, we need to follow

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[12]*Situation Ethics*, p. 69.

[13]*Ibid*, p. 134.

[14]If God is all-wise and good, then He will not ask us to do anything that is not best for us or for our neighbors. So the most loving thing to do would be to obey God. We must never forget that Jesus commanded us to love God first, and secondly our neighbor. It is reasonable to believe that our love for God will never be in conflict with our love to neighbors, but we may not be able to love our neighbors truly unless we love God first.

them when determining the best thing to do.

Are there any rules that are universal for humans, other than love? The only serious candidates I know of are the 10 commandments (it is of interest that when situationists take aim at law, they do so primarily at the 10 commandments). There are several reasons for their claim. First, they are the only words that we have that were not just spoken but directly written by God. Second, several of the latter commandments are repeated in the New Testament, often with the implication that they are synonymous with, or at least included in, the command to love one's neighbor.[15] Third, while provisions of the rest of the Mosaic law, specifically circumcision[16] and the sacrificial system[17] are declared to be non-binding, the provisions of the Decalogue are, if anything, tightened.[18] This is not totally out of keeping with the intent of the Decalogue: Jesus' command (to men) to avoid looking at a woman to lust after her is merely restating a provision of the 10th commandment which states, "You shall not covet your neighbor's wife." (Ex. 20:17, repeated in Deut. 5:21)

Are the ten commandments reliable as absolute standards? I don't know that one one can prove them reliable or unreliable using empirical evidence, due to the inherent limitations noted above in our methods. So we are stuck with how reasonable they are, and how strong is their revelational authority.

I will not try to cover all the evidence that could be adduced regarding the reliability of the 10 commandments as absolute rules. I will say that I am convinced that at this point they are the best indicators of good I know, not coming into conflict with the imperative of love in all my personal decisions, and often being a helpful corrective to my instinctive preferences. This does not mean that following them one will never have pain, or even apparently avoidable pain, but it does mean that a life of obedi-

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[15]See Matt. 19:16-22 = Mark 10:17-22 = Luke 18:18-23; Rom. 7:7-12;13:8-10; James 2:8-12.

[16]Acts 15 and multiple Pauline passages.

[17]See note 5.

[18]See Matt. 5:17-48. The law that Jesus says will not have one small letter or stroke pass from it "until all is accomplished" in v. 18, includes the Decalogue (vs. 21,27), and the command to love one's neighbor (v. 43). The rest of the Mosaic law could be interpreted as being changed (vs. 31,33,38, although in all fairness none of the reinterpretations may actually be in violation of the spirit of the original commands. Even the Lex Taliones of v. 38 may have actually been originally an upper limit to punishment rather than an exact prescription).

ence is likely to cause less pain and more pleasure for all concerned in the long run. The 10 commandments are reasonable, and often more reasonable than they appear at first glance to modern man. For example, take the first commandment, "You shall have no other gods before me." There is no reason to object to its spirit. There is only the objection to the letter that one may sometimes appear to worship other gods for good enough reason. But this assumes that life with compromise is better than martyrdom. A case can be reasonably made that God does not need double agents. In fact, double agents may be deceived into doing more harm than the good they plan to do later. They may not live to finish their plans. And they may even wind up switching sides without fully intending to at the start. Remember, Jesus was confronted with the same temptation and walked away from it. God may even have a surprise in store for us, as He did for the three companions of Daniel (Dan. 3), and possibly for Jesus Himself (the resurrection). The case against the first commandment is not strong enough for me.

The second commandment forbids the worship of images, or the making of images for worship. One may argue that historically the majority of Christians have ignored the import of this commandment. But perhaps the majority of Christians have not fully understood the value of this commandment. It may be as relevant now as it was when first stated. It might keep us from honoring the creature (even the "saint") instead of the creator, as suggested in Rom. 1:19-23 (This does not necessarily mean that people are "lost" if they bow down to images. We are now discussing the best actions, and actions which are not as good and therefore may be called harmful. We are not trying to establish the rebellion, or lack thereof, of the participants in those actions).

The third commandment forbids saying God agrees with something when He does not. The challenges to this commandment usually ask us to assume that we can control the situation, when we only have a certain amount of influence. Our control extends only to our own behavior (and sometimes not that far). It may be better to maintain our integrity than for us to gain some temporary good (Frankly, I have never seen a situation where invoking God's authority falsely actually could reasonably help someone, but I have seen multiple situations where invoking God's authority falsely, especially by professed Christian leaders, has resulted in disastrous consequences for many people).

The fourth commandment tells one to rest on the seventh-day Sabbath. Again the vast majority of Christians have not fol-

lowed the commandment. But they may be the losers. A day of rest from the constant grind of making a living may not only be desirable for physical health, but helpful to allow one time to meditate and communicate with God. This may be even more important in a culture which puts time pressure on people.

And the choice of day may be important. Some years ago Harold Lindsell wrote a book called *The Battle for the Bible.*[19] In it he documented the fact that within approximately fifty years after turning its back on the doctrine of the verbal inspiration of the Bible, a Protestant church would cease to hold any but minimalist Christian positions, barely distinguishable from the secular culture.

He made his point well. However, I was struck by the fact that there was one glaring exception to his general thesis. The Seventh-day Adventist church has from its inception specifically avoided saying that there were no errors in the Bible. And yet in its 150+ years it has never drifted anywhere close to where it is homogenized with society.[20]

One may attribute this to a number of different causes. However, I think that the most significant one is that the Sabbath stands guard over supernaturalist doctrine. Without the Sabbath, only an authoritative Bible (which is usually thought to require inerrancy) has kept one a supernaturalist. When errors have been allowed, the first one was usually assumed to be the creation story. If that story was myth, the pressure was on to remove more and more miracles until finally one capitulated on the resurrection of Jesus, completing the transition from supernaturalist to naturalist belief. However, with the Sabbath, one has a constant working reminder of the reality of Creation week with its inherent supernaturalism, and the finding of minor differences in the Biblical accounts does not lead to abandonment of the supernaturalist position. Perhaps the fourth commandment is also more relevant to modern life than previously thought.

The fifth commandment receives little objection. The same is true of the sixth if it is translated, "You shall not murder." And the ninth commandment is also relatively non-controversial as it reads—"You shall not bear false witness against your neighbor."

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[19]Grand Rapids, MI: Zondervan Publishing House,1976.

[20]I do not mean to say that it has not drifted, or that there is no possibility of further drifting, but that the more or less official church position, and the substantial majority of church members and leaders, are still supernaturalist with a wide gulf doctrinally between them and the modernist position.

The tenth commandment seems unexceptionable—in fact, it is the one commandment that a situation ethicist would be forced to agree with, as it deals with motives. That leaves "You shall not steal" and "You shall not commit adultery."

The prohibition against stealing becomes easier to swallow when we realize that stealing involves taking someone else's property (which he/she must therefore rightfully own), knowing that he/she does not (or would not) approve, and with the reasonable likelihood that it will not be returned intact (or that he/she will lose the use of it).[21] Even in the proverbial case of stealing to keep one's children alive, one has to ask whether there are better ways (prayer, or direct asking, for example) to accomplish the same goal, and one has to remember the loss of integrity that might result and the further cover-up behavior that might be required. And it is rarely the case that one stealing episode will suffice to feed children. If one is trying to control the situation, one must remember that the choice to steal once is usually the choice to make stealing a way of life, and one's children may still starve in the end, or pick up their parent's stealing habit.

We finally come to the commandment that sticks in the craw of modern man,[22] that which forbids adultery. It will do no good for a Christian trying to avoid obedience to appeal to the New Testament, for if anything the commandment is strengthened there. One of the four requirements that was made of the new Gentiles was to abstain from fornication (Acts 15:29; compare v. 20), and we have already seen what Jesus did with the commandment.

This is thought by many to be outdated. We no longer have to worry about pregnancy, venereal diseases, or discovery, they say. Contraceptives can prevent pregnancy, antibiotics can cure venereal diseases, and our urban and mobile society makes discovery unlikely, so the major reasons for avoidance of adultery no longer apply. Besides, the rule was made when women were considered property, and doesn't apply today.

This reasoning can sound plausible, particularly if one is in a difficult marriage, or if one is in the company of a sexually attractive person. But it is flawed. First, although perhaps it is somewhat less likely, pregnancy is still a major complication of

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[21]That is not to say that the spirit of the law , as in the case of the 6th and 7th commandments, does not go much further than the letter.

[22]I am using the term "man" in the gender-inclusive sense, although I suspect that men have more difficulty with the commandment than women.

extramarital sex, and even more so of premarital sex. Second, with the spread of herpes and AIDS (along with papillomavirus), the control of venereal diseases by antibiotics has become hopeless. And discovery, while technically more avoidable for each incident than in the past, is still a major problem.

The reason for the latter lies in the nature of adultery, and indeed of any clandestine activity. It can be (temporarily) enjoyable, or it can not. If it is not, it was not worth it almost by definition. If it is enjoyable, one is either caught or not. If one is caught, again it was not worth it almost by definition. If one is not caught, then one can stop after the first time, in which case over the long haul it is likely to cause enough frustration at not being able to repeat it to counterbalance the initial pleasure, not to mention the dishonesty required to keep it hidden, and the lack of openness and sharing with one's spouse and the damage this can cause the marriage relationship. But suppose one does not stop with the first time. The risks are now replayed, and although each individual time is unlikely to be discovered, eventually one will either stop (in which case the problems noted above will still apply), or one will be caught (in which case it is not likely that it will be thought to be worth it), or one finally loses enough interest in the marriage relationship to attempt termination.[23] In that case from a scriptural perspective at least (see Jesus' teaching on divorce), if not from a worldly perspective, one will have lost something of arguably greater value than the pleasure one got from adultery.

But what about "sacrificial" adultery, of the kind described in *Situation Ethics*, pp. 164-5?[24] The intention behind the presen-

[23]I say "attempt termination" because, as divorced people find out, the relationship never really terminates. The ex-spouse remains always in memory, if not as a complication of relations with mutual friends, children, monetary affairs, etc., etc.

[24]Briefly, the story is as follows: A Mr. Bergmeier in the German army was captured by the Allies near the end of World War II. His wife and children (15, 12, and 10 years old) were in the part of Germany overrun by the Russians. Mrs. Bergmeier was picked up by a Russian patrol and then taken to the Ukraine, without being able to get word to the children about what had happened. Mr. Bergmeier was released after the war, and found the three children. He then hunted for his wife.

Mrs. Bergmeier learned of his search from the commandant of the prison camp who reportedly was sympathetic. However, the camp rules did not allow release to Germany unless she became pregnant, when she would be considered a liability. She finally decided to have intercourse with a (German) camp guard, and became pregnant. She was sent back to Germany, where her family welcomed her, and also little Dietrich when he was born, and were reportedly grateful to him for reuniting their family.

tation of the case seems to be to present an actual case where adultery appears clearly to be the loving thing to do.

One can ask several questions about this scenario. These are legitimate, and do call into question what at first glance is the obvious conclusion. First, God's ability to act is left entirely out of consideration.[25] Second, were all the other ways of handling the situation exhausted? If the commandant of the camp was as sympathetic as he was described as being, could he not have let her family know where she was so they might try to get her released? We also do not know (and more important, she did not know at the time) how long the prisoners were kept in the camp after her release. A mother becoming pregnant by someone else in order to be reunited with her family might be understandable when otherwise she would never see them, but much less understandable if it only hastens the process by 3 months.

Secondly, one has to ask what the prospects of "success" (in this case reuniting with the family) are prospectively. One of the concepts that stands out starkly in medicine, and especially emergency medicine, is that all the really difficult decisions (perhaps all decisions) must be made prospectively. What makes some patients difficult to treat is that they do not have their diagnoses stamped indelibly across their chests. A person rarely comes in complaining of myocardial infarction. Most of the time the complaint is chest pain, or sometimes abdominal or back or neck or arm or jaw pain. I know of one case of sore throat which turned out to be critical myocardial ischemia. And often even after the proper investigation, we cannot be sure who has heart disease and who does not. We may elect to keep the patient in the hospital until we are sure. This means that we may admit 100 people to the hospital for every one that we eventually help. The fact that a patient was sent home and came to no apparent harm does not mean that the decision to send all similar patients home can be recommended prospectively. One has to have a group of patients, so that one can make reasonable estimates of risks and

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At christening time, the parents sent the children home and asked their pastor whether it was right for Mrs. Bergmeier to have done what she did, and whether they should feel grateful to the guard and happy with her choice and the child's appearance. Here the story ends.

[25]If the lady in the story honestly believed that God would not act to help her directly, then I cannot be sure that she was not motivated by love, but we are not discussing that. We are discussing the very best way to handle the situation, and the fact that the lady did the best she knew does not mean that with more knowledge she would, or at least should, have done differently.

benefits, before one can make recommendations.

And working prospectively, there are several uncertainties. The lady is dependent on the camp commander's word that she will be released if she becomes pregnant (this is the same commander that knows that her family is alive and looking for her, but can't get a message through to them). There is also the possibility that the intercourse she engages in will not result in pregnancy. Women in stressful situations such as concentration camps are known to be less fertile than usual. How long is she prepared to try? And if she tries and is unable to become pregnant, would she have been better off not trying? What is the probability of that eventuality? Her husband may also not be as understanding as he eventually turned out to be. Since the decision regarding adultery must be made prospectively, such uncertainties must be taken into account, even if they did not eventuate in this particular case.

Third, the story as told is not over. The husband may not be as accomodating in the future. What happens if little Dietrich finds out about his paternity? And if the "parents" try to keep this information from Dietrich? One can certainly see some complications that have not surfaced yet.

However, proceeding in this fashion is not likely to be much help. For one arguing for a situation ethics point of view will simply try to find a more obvious and extreme example, and eventually one is likely to be found. If there is nothing intrinsically harmful about committing adultery, eventually the case will be found where it seem the best in prospect as well as retrospect, and the theoretical point of the situation ethicist will be made, namely, that love can dictate the breaking of any rule, especially the ten commandments. In fact, for many, even given the above cautions, the case we have discussed has already made the point.

But one factor seems to have been overlooked, or more precisely denied.[26] That is that some actions have effects that are essentially inseparable from the actions themselves. For example, telling a lie, even one which the person has determined beforehand is "necessary", causes a psychological reaction big enough to be indicated by a physiological response. For another example,

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[26]For example, Fletcher insists that "no act apart from its forseeable consequences has any *ethical* meaning whatsoever . . ." (*Situation Ethics*, p. 126, italics his), and specifically, "If people do not believe it is wrong to have sex relations outside of marriage, it isn't, unless they harm themselves, their partners, or others."

policemen who shoot suspects who turn out to be unarmed and not dangerous are emotionally devastated, even though they may have shot them "in good faith" (there may be problems even when the suspect was armed and dangerous). Those experiences make for profound guilt experiences which are not easily psychologized away. Thus, for practical purposes, there are some means which are inherently worse than others, and which a simple preponderance of external factors in their favor does not justify.

Can the same thing be said of adultery? We will never know experimentally for sure. Sexual activity in and of itself produces physiological disturbances, so that an approach similar to a lie detector is not likely to be helpful. Any change could simply be attributed to the sexual activity itself. And in any case the most damaging part of the act may be the decision to commit it, which is not likely to be monitored, and if the decision were monitored any physiological reaction could be attributed to sexual arousal (this is in addition to the ethical difficulties in conducting the experiment, and the question of whether one trusts the experimenters to report and interpret the data accurately).

But theoretically it isn't too hard to believe. Consider what adultery is. It is deliberate sexual activity with someone when at least one of the parties has promised exclusive sexual commitment to someone else.[27] Thus adultery involves not only sexual activity, but also the keeping of promises. This is why the act can be damaging in and of itself. Adultery is an affront to integrity. One of the most important values, if not the most important value, is integrity. It is one that is necessary if we are to be safe to be around for eternity. And that means that adultery is intrinsically

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[27]It is interesting to note that God did not start by forbidding fornication, or sexual activity outside of personal commitment. He did not even forbid polygamy. From that one may deduce that adultery was a minimum requirement. The spirit of the law, of course, may extend beyond the letter.

It is also interesting that if we moderns were making the law, we would most likely have outlawed rape rather than adultery. While it sounds worse (and I think is worse), it is also harder to effectively define, both in prospect and in retrospect. Some cases are obvious. But one rapidly gets into the gray zone of he says/she says, with the man saying "but she enjoyed it", or "she is lying", and the occasional abuses from the other end such as the use of rape charges to get what one wants ("if you don't do what I want now, I will say that I really didn't want the sexual activity later." In all fairness, men's abuses in this area are probably far more common than women's). This can be particularly damaging in the marriage relationship. Thus adultery, which is usually more clearly defined, is actually more practical.

harmful, in a very important way. It can even be argued that this damage outweighs any good that adultery might do.[28]

This does not mean that no one can commit adultery without believing it to be the best course. I believe that in the example give Frau Bergmeier thought she was taking the best action. But that is not the same as saying it was advisable, or the best possible course under the circumstances.

The foregoing discussion is certain not to be pleasing to the modern secular point of view. It will be argued that pleasure, including sexual pleasure, is good, and we should stop making all those restrictive rules which crimp our style. Besides, some of those restrictions are ridiculous.

It is true that some have extended their restrictions to illogical lengths. Some have insisted that sexual intercourse is only for the production of children, and should only be engaged in with that end in view. This view, if taken to its logical conclusion, would not only forbid birth control but would also forbid intercourse except during ovulation, and would forbid intercourse with a spouse who had his or her gonads (or uterus) removed, or who was past menopause. It should also welcome artificial insemination as a way to have children without the "evil" of sexual intercourse. It also has trouble with the fact that sexual intercourse is so inefficient at producing children. It would seem that God intended that not all intercourse would result in children, and that therefore some intercourse serves some other purpose. God's original plan apparently included sexual intercourse.[29] Finally, there is the counsel of Paul in 1 Cor. 7:5, "Do not deprive each other except by mutual consent and for a time, . . . Then come together again . . ." It is difficult to see how Paul could say this if he had felt sexual intercourse to be intrinsically evil.

Some of the halfway positions are even worse. There is no motivational difference between using the rhythm method of birth control and, say, using a condom. Neither are, strictly speaking, "natural", and both are aimed at avoiding pregnancy while enjoying intercourse (and neither one is 100% reliable—the condom can break). For that matter, withdrawal is precisely analo-

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[28]If it is believable that adultery is never the best course, and if one believes that it was forbidden by God (and reinforced by Jesus), then one is obligated to try to follow their counsel. Deliberate disobedience at that point becomes rebellion as well as adultery.

[29]See Gen. 1:28. Before the entrance of sin, God said, "Be fruitful and multiply", using the same terms which He used in Gen 9:1, there obviously with sexual activity in mind.

gous to having intercourse at the "wrong" time of the month (neither takes any equipment), and yet some systems would condemn one and condone the other.

But if one grants that sexual intercourse within the God-given limits is good, it may still be true that outside these limits it is bad. God apparently intended that the sexual relationship be permanent, exclusive, and publicly declared. That is a pretty good definition of marriage.[30]

As for crimping style, any ethical code worth mentioning, including a situationist one, will tell one not to do some things that one *feels* like doing. Witness Fletcher: "But as Christians they [a young unmarried couple] would never merely say 'It's all right if we *like* each other.'"[31] Nor are we allowed, even in modern society, to rape.[32] Sexual activity is not to be indulged in regardless of the circumstances.

The present societal sexual restrictions are not necessarily optimal, either. One of the unexpected results of the loss of sexual exclusiveness is the spread of disease. Promiscuity is unhygeinic. One would not casually share toothbrushes with friends. One should be similarly cautious with genitals. This aspect was camoflaged by the advent of penicillin. But almost predictably, diseases resistant to antibiotics spread, such as herpes, papillomavirus, hepatitis B, and AIDS. If the population were to suddenly become monogamous, these diseases would die out within little more than a generation. Furthermore, an individual couple's commitment to monogamy virtually ensures that they will not get these diseases. So this solution is workable on a personal as well as a societal level. And there is no other solution which approaches it in efficacy.[33]

I will not enlarge on the topic further, except to point out that the ideal as understood by Jesus is still given in Genesis 1 and 2, and we do well to heed this advice.

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[30]Jesus took his model from Genesis 1 and 2. If one argues that these chapters were mythical, and expects me to take him/her seriously, then we need to go over the material in chapters 2-5 again. That is why they were presented first. Without them as a foundation, much of the rest of this book would be invalid.

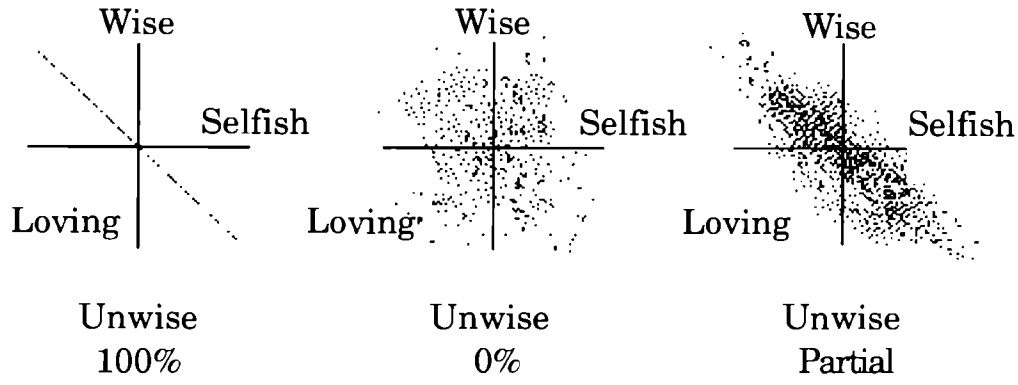
[31]*Situation Ethics*, p. 104, italics his.

[32]That is not to say that it doesn't go on, or even that it is always punished, but that it is morally and legally unacceptable.

[33]Some may wonder why so much space has been devoted to the seventh commandment compared to the others. It is because modern secular society usually considers sexual activity between consenting adults as victimless, not a crime, and not worthy of any sanctions, including from God. In fact, unless net damage is done, it is to be encouraged. This attitude has also infected the church (see Fletcher). Most of the other commandments are not nearly as controversial.

So love should be our motive, and the ten commandments should be at least one guide to conduct. One way of analyzing actions is to divide them into loving and unloving, and into wise and unwise, or best and more harmful. Some actions which are selfishly motivated may turn out to be objectively wise decisions, and some which may not be as wise may have been meant well. There should be some correlation, but for our purposes at least it may not be 100%. This explains why a term like "sin" which is used in one sense may be used in the other sense as well without the conscious differentiation always being made, and yet why it is not wise to confuse the two.

Correlations of wise with loving actions



Unwise	Unwise	Unwise
100%	0%	Partial

But this model without modification would suggest that without outside force and with adequate knowledge, one who is loving will always act in the best way. Some will maintain this. If your works do not measure up to their standards, and you have been warned, then you are without excuse and must be just basically selfish.

This view has trouble with Romans 7 where Paul says, "For I delight in the law of God, in my inmost self, but I see in my members another law at war with the law of my mind and making me captive to the law of sin which dwells in my members." (vs. 22-3) Paul is apparently speaking from personal experience, as he uses the first person. Furthermore, it is evident from both the Bible (for example, 1 John 1:8-10) and personal experience[34] that con-

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[34]No converted person that I know of has suddenly changed his actions to absolutely ideal ones on a permanent basis at the moment of conversion. Those who say they have are often the most blind.

version does not result in perfection understood in the usual sense of the word. This brings us to sin as addiction.

The idea that sin is addictive is as old as the Bible. Jesus noted in John 8:34 that "every one who commits sin is a slave to sin." Proverbs 5:22 speaks of the sinner as, in the phraseology of the King James Version, "holden with the cords of his sins." It is also becoming increasingly recognized today, as the model for alcoholism has been found to fit other compulsions to a degree which is surprising considering the varied physical nature of the practices involved. It might even be proposed that all sin rapidly becomes an addiction, and the only reason we do not have a greedy people anonymous or a prideful people anonymous or a bigots anonymous is because the sins in question are harder to define and detect.

This leads to the question of whether the 12-step program, arguably the most successful way to deal with addictions, is not inherently Christian in the highest sense. Perhaps both Christianity and 12-step programs might be benefitted by a constructive dialogue (in fact, there has probably been some such dialogue).

It also means that we must be careful assigning motives to people who do what we dislike. They not only may not understand, but also they may be acting under compulsion (and our likes may need correcting).

Some would also define a sinful nature. Presumably this nature is demonstrable in some way otherwise a scientific theology would have trouble accepting it. It could be equivalent to a characteristic of actions apart from the will (like an addiction at certain points), or it could be part of the attitude of selfishness, or else it could be otherwise demonstrable. Perhaps it is like the inherited tendency to alcoholism.

I will now stop building this model of sin, not because one could not go on, but because one could go on forever. Then the observations made so far will not be published. I will summarize by saying that there is no single completely adequate Biblical definition of sin, but that the term is used for a cluster of related concepts. Sin can be a matter of selfish attitude, a matter of harmful action, or it may be an undifferentiated combination of the two. It may also be an addiction, which is presumably equivalent to a character trait. It may even be a "nature", whatever that is.

When we read the word in a Biblical text, or a theological construction, it behooves us to ask what definition is in the mind of the writer.

9

Salvation

We have already discussed in chapter 7 the difficulty with taking as a completely accurate description a model of salvation that says (either explicitly or implicitly) that Jesus fools God, or even persuades God, into saving people who really don't deserve it but have said the magic words.

It is now worthwhile examining another model of salvation, that provided by the Council of Trent.[1] The section on justification is rather short: the English translation comes to less than 27 pages.

The first "chapter" (*caput*) is entitled Of the Inability of Nature and Law to Justify Men, and discusses the inability of mankind to become righteous by his own will, even with the help of the law. Chapter 2 discusses Christ's death for our sins. Chapter 3 discusses who are justified (only those who are "born again").

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[1]For a complete text in the original Latin and an English translation, see Schroeder HJ: *Canons and Decrees of the Council of Trent*. St. Louis: B. Herder Book Co., 1941.

Chapter 4 discusses the necessity of at least a desire for baptism, and preferably baptism itself. Chapter 5 states that the beginning of justification must proceed from God. We can accept it when God gives it, but we cannot choose to be just without the grace of God (*gratio Dei*). Chapter 6 notes that faith is received, presumably from God. All the steps to justification (faith, turning from sin and to God, repentance, and the resolve to be baptized) are received from God, and our part is only not to reject the gift. Chapter 7 discusses justification, which includes sanctification as well as what Protestants would usually call justification. This also is the work of God. The latter point is reinforced by chapter 8, which also states that we are justified by faith.[2]

Chapter 9 then states that no one can be certain of salvation, and decries the view that the assurance of salvation is necessary for salvation. Chapter 10 discusses the increase of justification (which, remember, includes sanctification), apparently stating that it is by faith cooperating with good works (*cooperante fide bonis operitas*). Chapter 11 states that it is necessary for one who has become justified to keep the commandments, and also possible to do so. It decries the teaching that even our best works after conversion merit eternal punishment. Chapter 12 condemns the doctrine of predestination. Chapter 13 states that one must perservere in good works if one wishes to be saved. Chapter 14 discusses penance. It says that those who have forfeited the received grace of justification (*accepta justificationis gratia*) can be justified again, but the repentance required for this forgiveness is very different (*multa aliam*) from that of baptism, for it also involves confession and absolution, as well as penance, or temporal punishment. Chapter 15 says that mortal sins may cause one to be cut off from grace (presumably damned), even if one still believes the truth. Finally, chapter 16 says that final salvation is both a result of God's grace and of our own good works. One should not trust or glory in oneself, but rather the Lord. One should not even judge oneself. But God will judge every man according to his works. Then follow condemnations of various positions which the Council presumed to be in error.

To synthesize, according to the Council of Trent, and therefore official Catholic doctrine, we are not naturally able to choose rightly, or to save ourselves, although (canon 7) apparently we can sometimes choose a less sinful course. Then God's grace at

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[2]Since sanctification is included in justification in this scheme, we presumably are also sanctified by faith.

some point draws us, and if we choose not to resist it, we will be given a new nature, or be born again. We then wish to be baptized and will be baptized if possible. The faith by which we are saved is a gift, like the grace of God. When God saves us, He not only declares us righteous but gives us righteousness, so that His declaration is not a fraud.

Since at this point God has given us his righteousness, we are then able to keep from sinning.[3] Thus if one sins after justification (or conversion), one has somehow lost the grace originally given, even if one still believes in the doctrines of Christianity (which the Council apparently identifies with faith in chapter 15 and canon 28). Therefore, if one has sinned, one is obligated not only to repent but to confess to the priest and to do penance (if not in this life, then in purgatory). However, if one does not sin in a situation where one could, it is credited to one's account—one merits an increase of grace (*mereri augmentum gratiae*).

On the other hand, except in a special case such as the Virgin Mary, which is given by God, it is held that one cannot avoid all sins, so repentance will be usual among Christians. Because one cannot be sure of one's own ability to stand, one can not be sure that one is in grace, that is, saved. One would be told explicitly by the Council that one should not claim to be eternally saved (canons 15, 16).

At this point, some of my Protestant friends are starting to squirm. They have always thought of themselves as anti-Catholic, and yet except for penance, purgatory, and the storehouse of merit, their belief comes remarkably close to the Catholic position.

Yet more of my Protestant friends will squirm when the realize that a superficial difference between their position and the Catholic position obscures a fundamental similarity. For it does not really matter whether sanctification (the living, or perhaps the ability to live, a holy life) is one aspect of justification or simply always accompanies justification, as long as the two are inseparable, and we understand the intended meaning of a given Biblical writer whose usage of the words (as opposed to the concepts) may not always conform to ours.[4] So the insistence that

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[3]Sin is not explicitly defined here, but is apparently related to the commandments of God (*Dei praecepta* or *mandatorum dei*), which includes the ten commandments (*decem praecepta*).

[4]In fact Biblical Greek does not distinguish between righteousness and justification, using the one word *dikaiosunē* which has been translated both ways in English.

justification is concerned with how God looks at us and does not include sanctification, or His changing us, will not serve to fundamentally differentiate one from the Catholic position unless one is prepared to say that some people can be justified without being sanctified. Few Protestants would take that step, and for those who would, Catholic arguments about the parable of the sheep and the goats, and Bonhoeffer's objections to "cheap grace", apply with full force.

But if there is that little difference between the Catholic position and most Protestant positions on righteousness by faith, then why all the fuss? It can't be over the abuse of indulgences, because the Church recognized and attempted to correct these. It could be partly over authority, and the Church's insistence that it is always right, but that would not be a significant issue unless the reformers felt that the Church had made some major errors. It could be that the reformers felt that the doctrines of the storehouse of merit, penance, and purgatory were wrong and inherently invited abuse (and there is a great deal of truth to that—Luther's 95 theses were sparked by such abuse), but the reformers constantly pointed to the doctrine of justification by faith as the crux of the argument. One might even blame it on the personalities of the the reformers, but that fails to explain why so many believed them. We are missing something somewhere. So let us go back over the doctrine, paying attention to alternative models.

First, almost all the traditional theologians are in agreement that before God changes the course of a life (I would say "touches a life", but according to chapter 2 God does that all the time), there is nothing that anyone can do to merit salvation. This is certainly in accord with Paul's theology as given in Romans. To put it another way, we all start out under the power of sin. I take this to be "original sin". Usually this sin is not closely defined, as I attempted to do in the previous chapter. That is, it is not clear whether "original sin" is an addiction or merely the propensity to make mistakes. It is hard for it meaningfully to be called rebellion, as rebellion usually implies a choice, and what is specifically denied here is a choice (in addition, it is hard to understand how infants, to which the doctrine is intended to apply, can meaningfully be said to have rebelled).

It is sometimes argued that we are naturally good and that we become corrupted by our enviornment. Who does not look at a baby (some babies, anyway) and think how sweet and innocent it looks? But that feeling is not necessarily to be trusted. One could say the same of a lion cub. One may then argue that the lion it will grow to

be is a necessary part of nature's balance. But that does not make it the ideal, or fit for a deathless world, where "the lion shall eat straw like the ox" (Isa. 65:25, apparently an echo of Eden where, according to Gen. 1:30, "to every beast of the earth . . . I have given every green plant for food.")[5] It is difficult to make a strong enough argument from appearances to override the Biblical data.

Perhaps of more concern is the argument that it isn't fair to damn people for something that is not under their control. The basis for the argument sounds plausible. But first, it assumes that God will not provide these people a way to be saved (which is mostly untrue, as we will see), and second, we are not talking about whether these people should be damned to eternal torment, but rather whether they should be saved. There may be some who are neither saved nor damned in this sense (we will discuss this more in the next chapter). The theory that we are discussing suggests that people, without God's special attention, can be fairly compared to rabid dogs. They are not responsible for their behavior, but still cannot be allowed in society and must be destroyed.

One might argue that "most of the people I know do not resemble rabid dogs at all. They are nice, hard-working, and honest, and this includes atheists." This argument misses two points. First, it is possible at this point (we will discuss it more thoroughly later) that some atheists are safe for God to save, and if so, one cannot use them without qualification as examples of people with their "original sin" intact. Second, remember that some rabid dogs do not resemble "rabid dogs" either. Early on in the disease, there may not be any perceptible change. The dogs may be cute and friendly. But with time, the condition will become worse, and the dogs must be destroyed. Just so, those who are fatally infected with the sin "virus" may seem to be functioning pretty well also. But given enough time (and we are talking about eternity here), they may develop horribly twisted characters, and it may be obvious that they must go.

If the doctrine of original sin is correct, then we do need to be saved from the results of that sin, which are first addiction, and then death. Traditional Catholics and Protestants agree, following Paul in Romans among other Biblical passages, that we can-

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[5]This is one reason why a natural theology can be misleading, and it is important to establish whether the Biblical record is reliable and if so to use it. Some theologians try to establish a theology which is true no matter what the scientific or historical facts are (kind of a lowest common denominator theology). Those theologians wind up not being able to say much that is meaningful, or trying to ignore the Biblical record, or both.

not do this of ourselves. We need help from outside ourselves. And both agree again that God takes the initiative in attempting to save us. He at least gives us the choice.[6] John says that "the true light . . . enlightens every man" (John 1:9). In one model, God gives us all, at least at one point, freedom of choice in this matter. In the other (the Calvinist model) we have no actual choice. God simply decides for us.

I have trouble with the Calvinist model. It leads either to universalism, which Jesus did not teach, or to one's believing that God is grossly arbitrary. It is ethically much easier to believe that people are arbitrary. The Calvinist model also denies to man the power of choice, which seems intuitively to be present. And its predictions are either falsified or indistinguishable from the predictions of a limited free choice model, and therefore for practical purposes can be ignored. Note that Calvinists still preach as if they were trying to persuade people to accept the Gospel.[7]

Again, traditional theologians agree, following Paul, that God's grace is given without our having earned it. If we ignore the Calvinist option, then we are, at the point of grace, given a choice as to whether we will accept it or reject it. The acceptance of grace is experienced as a choice of faith, which is itself a gift of God. We then are counted righteous by God.

There are multiple models of exactly how God does this. They divide roughly into three categories. Some models say that when God counts us righteous, this action has nothing to do with whether we are in fact righteous. These models seem to lead naturally to libertinism. Do what you want to; God has already saved you, they say. Historically, libertinism has been one outgrowth of this position. And this position seems to run afoul of Jesus' teaching, which has specifics on actions. Jesus said bluntly that "evil

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[6]Some would argue that He does even more than that. He actually makes the choice for us. This view is discussed shortly.

[7]This argument is parallel to the best argument I know against solipsism, the belief that all one experiences is a product of one's own imagination. You cannot "mathematically" prove that this book and its writer are not figments of your imagination, along with everyone you meet. But the predictions of that theory are either wrong or completely parasitic on the theory that the universe is real and separate from you, and therefore the theory can be ignored.

There are a number of texts which mention some form of predestination. Some of these fit easily into a determinist theoretical framework. But they mandate it only if one ignores Romans 8:29 which suggests that foreknowledge precedes predestination, or if one insists that divine foreknowledge precludes human freedom. We discussed the latter concept in chapter 6.

thoughts, murder, adultery, fornication, theft, false witness, [and] slander. . . . defile a man; . . ." (Matt. 15:19) And when He was telling the final parable about His second coming, where the sheep and the goats were separated (Matt. 25:31-46), the separation was not done on the basis of their belief system but rather on specific actions. This fits with Matt. 7:21 where Jesus said, "Not every one who says to me, 'Lord, Lord,' shall enter the kingdom of heaven, but he who does the will of my Father who is in heaven." Righteous actions have something to do with salvation.

The next collection of models is somewhat heterogeneous. It says that God gives us perfection at the same time we are (legally) accounted righteous. This collection can be divided into two groups, the models saying that we achieve absolute perfection permanently, and the ones who say that we have it only for a limited time.

The theory of permanent perfection is theoretically the most attractive. It would (if true) make our choice final and keep us from ever sinning after conversion (see 1 John 3:6,9;5:18). But real life does not happen that way most if not all of the time, and the theory runs directly afoul of 1 John 1:8; "If we say that we have no sin, we deceive ourselves, and the truth is not in us." (see also v.10;2:1) Permanent perfection is apparently not what God offers us at conversion.

Then what about temporary perfection? It would explain the aforementioned texts in 1 John. It also does not require God to save those who are committing sin. But it would seem to deny the possibility of growth, which is implied in several Scriptural passages (e. g. Heb. 5:11-14). And experientially, many people accept Jesus as Lord of their lives before they are aware of the full implications of that decision, and while they continue to do things that are not the best. As long as one defines sin as harmful actions, it would appear that sinlessness is unusual even in converted Christians. This would not speak well of the power of God to save, if one will always have temporary perfection when one is saved. I am particularly troubled by the on again, off again quality of salvation in this theory, dependent not upon the choice of the individual, but on circumstances beyond his/her control.

In fact, even the Catholic position will not go this far. Some sins will not disqualify one from heaven; they will simply require purging before one can go to heaven (therefore purgatory). Some Catholic theologians will insist that although purgatory involves suffering, it is with eagerness to be rid of sin that the soul endures, giving purgatory an almost pleasurable quality which is

much different from Hell. That concept is not that much different from the variation in rewards that many Protestants teach.

So it would seem that some kind of less absolute relation between sin and salvation is more likely to be correct. To simply say that saved people commit less sin is not very helpful. Do they commit 50% less sin? Does it require time to reduce the sin level? Is sanctification the work of a lifetime, as has sometimes been said? In that case how long does a life have to be? What about the thief on the cross, who was saved with approximately 3 hours to go?[8] This approach does not seem very satisfactory.

Perhaps God stops us from doing particularly "bad" sins. This reminds us of the Catholic distinction between mortal sin and venial sin. But then, which sins are mortal and which sins are venial? Is there a minimum requirement for salvation, perhaps keeping the 10 commandments? Does God not really care about the other sins? Somehow this approach is not satisfactory either, at least without some adjustment.

One Catholic way of modifying this position is to say that disobeying *any* command of God (or the Church, which is thought of as coming from God) can become a mortal sin, but only if one understands fully (or fully enough) its implications, including its direct opposition to God, and one is free to choose without undue duress (there is always some pressure or one would not choose the action), and one chooses to do it anyway. This would seem to rule out any action as in itself sufficient to be a mortal sin, but to allow any action to be the basis for a mortal sin. Bringing in our previous discussion of sin, a mortal sin would be a sin of selfishness and rebellion. Harmful acts, and even sins of addiction, would be venial sins, as long as we truly did not know them to be against God's will and/or were not able to avoid them (perhaps because we did not know they were avoidable).

This position is very attractive. It predicts no deliberate sin while one is in Christ, and therefore can accomodate a kind of perfection, as seems to be indicated by the texts in 1 John 3 noted above. At the same time it allows for other kinds of sin, as apparently demanded by 1 John 1 and 2 and indicated by Romans 7. And while making

[8]His legs were broken in all probability not so that he wouldn't be able to run away, but so that he couldn't support his weight and would asphyxiate sooner.

allowance for human weakness it does not allow us to deliberately take advantage of God's forgiveness to cloak cherished sin.[9]

So far I have not diverged significantly from Catholic theology. However, I am not a Catholic. I do have trouble with the Catholic doctrines of penance, the storehouse of merit, the lack

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[9]This model appears to deny the doctrine known as "once saved, always saved." If that doctrine is taken to mean that God knows the end from the beginning and knows who will be finally saved, then I have no trouble with the doctrine, and the doctrine is compatible with the model. In fact, it would seem to be required by the considerations of chapter 6.

But if the doctrine states that a true conversion experience guarantees that one will be saved in the end, then I have a great deal more trouble with it. From a theoretical point of view, Paul seems to have worried that that after he had preached to others he would have become "disqualified" (*adokimos*—1 Cor 9:27). The Greek word is used in other contexts (Rom 1:28; 2 Tim 3:8; Titus 1:16; Heb 6:8) to designate people who are lost, and the burden of proof is on those who would assert a different meaning here. Hebrews speaks of "those who have once been enlightened, who have tasted the heavenly gift, and have become partakers of the Holy Spirit, and have tasted the goodness of the word of God and the powers of the age to come," who then "commit apostasy" (6:4-6), and again, "if we sin deliberately after receiving the knowledge of the truth, there no longer remains a sacrifice for sins, but a fearful prospect of judgment, and a fury of fire which shall consume the adversaries." (10:26-7)

From an experimental point of view, traditional Christian doctrine says that the Devil was once an archangel, and therefore "saved". One cannot insist on only one choice per lifetime, or else one guarantees Adam a place in hell (whatever and whenever that is), which seems unlikely, especially in view of the hope that seems to have been given him in Gen. 3. And the Corinthian church was advised to put a fellow believer who was sleeping with his father's wife out of the church, "that his spirit may be saved in the day of the Lord Jesus." (1 Cor 6:5), which implies that if they did not do so his "spirit" might be lost. Admittedly one cannot prove that he had been converted, but he had certainly confessed Christ. And remember, "Is Saul also among the prophets?" (1 Sam 10:11-2) There seem to be Biblical characters who were saved once and lost later.

From a phenomenological point of view, there are those who claim a conversion experience who later deny the validity of that experience and act accordingly. Either they are "saved" anyway (a conclusion which I find grotesque), which seems to go against the bulk of the Biblical material (see specifically the discussion of this problem in Eze. 18:21-32), or else they are not "saved" now. In that case either their conversions were genuine, in which case "once saved, always saved" is dead, or their conversions were not genuine. Then either one can find a difference between their conversions and those of people who perservere in their commitment, or else from a practical point of view one has conceded the point that "conversions" which look and apparently feel genuine do not guarantee salvation.

One can always explain away any evidence contrary to "once saved, always saved", but the explanations seem strained to me, and reduce the theory to

of assurance of salvation, and the definition of faith.

I am not sure that the process of forgiveness is fundamentally different after the conversion experience than before. It is true that one usually has more awareness of the consequences afterwards than before. But this would seem to be more a matter of degree than of kind. Repentance is acknowledged to be the same. Restitution is also to be encouraged at conversion, judging from the experience of Zaccheus (Luke 19:1-10, esp. v. 8), and is not always physically possible for sin after conversion.

This leaves confession and penance as the major difference in the Catholic system between forgiveness of sins before conversion and after conversion. I have little problem with confession as long as it is not adhered to mechanically, and I sense at least in the language of the Council of Trent some flexibility on this matter[10] (it also seems that confession may be helpful for sins before conversion). But I have trouble with the concept that the Church can always prescribe the exactly proper temporal punishment for a sin. In practice this can mean that a corrupt priest who bought his office from a corrupt bishop makes the pronouncement. This is not just a theoretical case. In some parts of history the corruption is generally acknowledged (even by Catholics) to have extended to the Pope.[11]

The only defense of such a system is that God somehow honors the dictates of these people. This is based on the "keys to the kingdom" concept (Matt. 16:13-20, esp. v. 19; see also Matt. 18:18; John 20:23). My problems with this approach are threefold. First, I accept that it is reasonably probable that Jesus is speaking to Peter in Matthew 16. However, if one insists on a literal and permanent interpretation of this passage then it seems difficult not to take literally the immediately following passage (vs. 21-23), where Jesus apparently calls Peter "Satan". The literalistic interpretation would thus make Satan the head of the church. But without a literalistic interpretation the doctrine of Petrine su-

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where it commits to no testable predictions. I am sympathetic to the aim of providing a sense of security in one's salvation, but think there is probably a better way of doing so.

[10]This flexibility may not always be translated to the popular level, but one should not hold the best Catholic theology responsible for this without further evidence, any more than one would, without further evidence, hold the best Protestant theology responsible for all abuses and erroneous concepts that may have crept into Protestantism.

[11]See, for example, Chamberlin ER: *The Bad Popes.* New York: The Dial Press, Inc., 1969.

premacy, and the keys to the kingdom, cannot be sustained (see also 1 Cor 1:12 where the Petrine party seems to be no better than the party of Paul or Apollos, and what seems to be needed is the "party" of Christ).

Second, there is no indication in the text that there is to be a succession, let alone that this succession is a mechanical (as opposed to a spiritual) one. Whatever authority authority Peter had could not be passed down without either a spiritual person to accept it (which we have seen is not the case), or a purely formal action. There is even some evidence that such a succession was not developed until the second century.[12] So belief in infallibility of the Pope rests on very shaky evidence.[13]

The storehouse of merit seems to be directly contradicted by Jesus. In the Parable of the Laborers (Matt. 20:1-16) Jesus seems to indicate that the final reward is not significantly increased (except for the pleasure of working for the Master and the security in the interim) for those with longer service. In Luke 17:7-10 (a parable commonly avoided) Jesus seems to indicate that we can not pile up extra "merit"; we can only do our duty. Jesus can

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[12]Strand, KH: "Church organization in first-century Rome: A new look at the basic data." *Andrews University Seminary Studies* 1991;29:139-60, and Strand, KH: "Governance in the first-century Christian church in Rome: Was it collegial?" *Andrews University Seminary Studies* 1992;30:59-75.

[13]The infallibility of the Church seems to fly in the face of empirical evidence. We have already noted the fact that corruption has reached the top of the heirarchy. One can attempt to avoid the obvious implications of this fact by insisting that infallibility only applies to church doctrines, or perhaps to the Pope speaking *ex cathedra*. But that very concession would undercut the doctrine of penance, and therefore scuttle the claim of at least a priest administering absolution to infallibility, and would probably ruin the claim to infallibility of Church councils like that of Trent. In addition, there are inconsistencies between the teaching of the New Testament church and that of the later church, such as the Sabbath (see Bacchiocchi S: *From Sabbath to Sunday.* Rome: The Pontifical Gregorian University Press, 1977), and inconsistencies between the Church which excommunicated the Patriarch of Constantinople (which was believed to have eternal consequences for him and his followers), and the Church which is now apparently accepting them as fellow Christians. The Church's suppression of the second commandment on a popular level (See, for example, Geiermann P: *The Convert's Catechism of Catholic Doctrine.* St. Louis: B. Herder Book Co., 1952, pp. 48-9; Chrysostom J: *Manual of Christian Doctrine.* Philadelphia: J. J. McVey, 1920, pp. 233-49; and [No author given]: *Catechism of Christian Doctrine.* Milwaukee, WI: Diederich-Schaefer Co., 1885, pp. 25-27) is also of some concern. The doctrine of transubstantiation smacks quite literally of hocus pocus. However, my most important concern will be detailed in the next chapter.

conceivably have extra "merit", but it would seem overly proud for any of us to claim such, let alone to be able to transfer it to someone else, as the theology of indulgences would require.[14]

The possibility of an assurance of salvation would seem to be taught by several Biblical passages, among them 1 John 5:13. I do not see it as a requirement of salvation, for in 1 John 3:20 we read that "whenever our hearts condemn us, . . . God is greater than our hearts, and he knows everything." This presumably means that someone who temporarily loses the assurance of salvation may still be saved. Nor is the assurance of salvation a guarantee of salvation: " . . . let any one who thinks that he stands take heed lest he fall." (1 Cor. 10:12) But it does seem that God wants us, after we are saved, to worry less about our own salvation (and perhaps more about that of others, His glory, and the truth). I agree that if pushed one cannot know for certain about one's salvation. But one cannot know for certain in that sense about anything. One simply should know enough to where one stops worrying all the time. In that sense the Council of Trent did a disservice to the average Christian.

Finally, the Council seems to define faith as belief in the cardinal doctrines of the Church, what is sometimes called the Faith, the kinds of things which might be listed in the Apostles' Creed, for example. James (2:19) properly ridicules this kind of belief: "You believe that God is one; you do well. Even the demons believe—and shudder." I would prefer the definition that faith is belief in God's goodness (as Jesus revealed it) sufficient to attempt action based on that belief. This kind of faith will not need the constant threat of eternal torment, or even the loss of eternal bliss, to keep it in line. It will naturally want to do as much of the will of God as it can see. Thus the entire structure of external rewards and punishments is not necessary to keep this faith in line, and is sometimes even declined (see Ex. 33:32; Rom 9:3). It is only as we try to guarantee the creation of a Christian community or nation that we fall into the trap of trying to scare or bribe people into heaven, and perhaps that attempt should not have been made in the first place (see John 18:36, Matt. 26:52-4). The

[14]Some will wonder why the abuses of indulgences (or for that matter the Church's historic restriction of access to the Bible, or its persecution of various dissenters) is not featured more prominently here. The reason is because we are obligated, when dealing with a theological position, to take the best possible construction. Thus, if the Church later condemned abuses of indulgences, we have no business making these abuses part of (the newer) Church theology unless we can clearly show that they are still a natural outgrowth of that Church theology.

impulse is understandable but not necessarily correct.

My opting for faith as primary for salvation would seem to put me on the Protestant side of the Reformation. However, the Catholic side could easily say, "What about texts like 'Work out your salvation with fear and trembling;' (Phil. 2:12) 'faith apart from works is dead' (James 2:26—see the whole passage, vs. 14-26); 'the Son of Man . . . will repay every man for what he has done' (Matt. 16:27); and 'by your words [a kind of work in this setting] you will be justified, and by your words you will be condemned' (Matt. 12:37)?"

Perhaps most striking, there is the parable of the sheep and the goats (Matt 25:31-46). Jesus seems to indicate that it is not our doctrinal purity, or even our faith as defined above, that will form the basis of the final judgment, but rather our helpfulness to our fellow humans. God seems to be using works (and not even "religious" works) as the criterion of salvation.

And theoretically, unless we are willing to completely divorce faith and works, we are inevitably forced to admit the possibility that works, when in their proper context (which only God knows completely now), are perfect indicators of faith. That means that works can be used to judge faith, and God is within His rights to do so. Thus one can both be justified by faith and by works (as indicated by James 2:21-26, esp. v. 24). But that brings us to two practical points where the Reformers were fundamentally more correct than the Church. First, Jesus indicated that when one is intending to change behavior, it is not helpful to aim at the behavior first. One should first change the fundamental attitude. Over and over He indicated that the change must come from within (see Matt. 23:25-8; Luke 11:31-41; Matt. 15:11,17-20; Mark 7:17-23; Matt. 12;33-5; John 3:3,5). A primary focus on the outside (works, even the works which Christ is doing in us) would thus go against Jesus' advice. It would be better to focus instead on inward qualities like faith and love (and perhaps even better to focus on God Himself, the object of our faith). Strictly speaking, this may not be anti-Catholic, but it is not the emphasis that comes through in the Council's pronouncements.

Second, focusing on works is likely to be deceptive. The very parable used to prove that works are the criterion used in the judgment bears this out. The "sheep" are surprised when good works are attributed to them, and the "goats" are similarly surprised when their omission of good works is pointed out to them. They may or may not be surprised at which side they are on, but the sheep did not expect to get there because of their works. Some

of the sheep must have read the parable ahead of time, and still they are surprised. The easiest way to account for their surprise is to say that they were not thinking of whether they were doing something good when they did it, but rather thinking of the other person's need.

In any case, one may temporarily control behavior with threats and promises, but if one wishes to effect the inner change necessary for salvation from sin one will emphasize faith over works. If we wish for an indicator of our spiritual condition (including our salvation), we are better off asking about our faith than about our works. If our works seem to indicate a problem, we should spend more time inquiring about our faith than our works. For this reason, whatever the faults of their models, the Reformers were closer to the truth of the matter than the rest of the Church at their time.

The situation is a little bit like someone trying to hit a baseball. The one thing any coach will tell you is "keep your eye on the ball". In order to hit the ball with the bat, you do not look at the bat, even though it is what hits the ball. You do not look at the pitcher, the other fielders, your feet, the outfield where you want it to go, or anywhere else. You do not close your eyes. Changing your stance may be a good idea, but you had better not look at your stance, or you will never hit the ball except by accident. Just so, focusing on what God is doing inside of us, or what we think He should do inside us, or the mess we have inside us, is not helpful, except as it drives us to look at God in Himself. We need to focus on what God is like in Himself, and what He has done for us.

But that puts a great deal of weight on one's faith, and means that we are well advised to determine to the best of our ability what that faith is. First, it would help to note what that faith is not. We have already seen that it is not mere mental assent to doctrinal positions.

Another model of faith is that it involves absolute certainty about something. This model usually starts by quoting James 1:6-8: "But let him ask in faith, with no doubting, for he who doubts is like a wave of the sea that is driven and tossed by the wind. For that person must not suppose that a double-minded man, unstable in all his ways, will receive anything from the Lord." But is it really true that one without 100% faith is automatically disqualified from receiving anything from the Lord? What about Peter who had "little faith" (*oligopistos*; Matt.14:31) but was able to walk on water? What about the father of the demoniac in

Mark 9 who cried out (v. 24), "I believe; help my unbelief!"? What about Martha, who believed in Jesus (John 11:27), but not that he was going to raise the dead (v. 39)? Of course, it may be claimed that all these people finally came to wholehearted belief, but that claim seems strained at least for the father of the demoniac. So the preferred model of faith should not require total belief. Belief enough to involve commitment to appropriate action should be enough.

Is commitment to action necessary? Some would dispute this. They would say that the thief on the cross (Luke 23:39-43—the parallels of Matt. 27:44 and Mark 15:32 do not mention his conversion) did not do any great work. And if one were to have asked him, I am sure that he would not have claimed to do any work. But consider that words are also actions, and that in an enviornment in which he could only expect to receive abuse for his words, he rebuked his fellow thief for his mocking Jesus, then confessed Him to be the coming King. That certainly should qualify for some kind of work.

We now turn to the object of faith. Faith is not an attribute that can stand by itself (unless it is faith in faith, in which we get into an infinite regress). Faith must be in something else. This means that to strengthen faith we must concentrate, not on the faith, but on the object of our faith. But what is the object of our faith?

The evangelical Christian would immediately answer, "Faith must be in Jesus Christ." For the Bible says, "Believe in the Lord Jesus, and you will be saved . . ." (Acts 16:31), and, "there is no other name under heaven given among men by which we must be saved." (Acts 4:12) It is tempting to stop there, and say that our belief must be that Jesus was the Messiah, and properly addressed as God (or perhaps is Lord of our lives). Certainly any model of salvation must agree with Peter and Paul in these situations, or do a good job of explaining why it does not.

But this model is not a complete model. For it implies that nobody who lived before Jesus should have been saved, which is contradicted by the New Testament accounts of the transfiguration where Moses and Elijah obviously came from heaven (and that before Jesus was crucified). There is also the New Testament opinion of Abraham as the father of the faithful. And it seems highly unlikely that the first 2/3+ of Earth's history was totally devoid of persons whom God could save.

Nor can we get out of our difficulties by adopting dispensationalism. For this would leave out of the Kingdom those

faithful Jews (in Berea, for example—see Acts 17:10-2) who died in the AD 30-50 range and never heard of the name of Jesus, and presumably continued to send their yearly offerings for the Temple sacrifices. No, the dividing line cannot be time; if it exists it must be knowledge. In that case, those who grew up devoid of knowledge of who the Messiah was in the 20th century should not be held accountable for that knowledge when they did not possess it.

How much knowledge is necessary? Was it necessary to know that a Savior was coming? If one reads the Old Testament one gets hints that a Savior was coming, and that there was some correlation between the sacrificial system and this Savior, but the hints have to be ferreted out, and perhaps most importantly, the messages of the prophets do not make the point explicitly and continuously, which means that they were not aimed at the vital goal of saving souls, if the knowledge of a coming Savior is vital to salvation. If God gave the prophets their messages (and I believe He did), then He gave them the appropriate ones, and it is easier to say that the doctrine of a Savior, while important, is not the one indispensible subject of faith.

The only time that Jesus is recorded as using the verb *dikaioō* (to justify) to indicate that someone was justified, other than Matt. 12:37 cited above, is in Luke 18:13-14, where a man prayed simply, "God, be merciful to me a sinner!" Jesus said that this man was justified, in spite of the fact that he did not mention Jesus' name, or even a coming Messiah.

In fact, there are passages (including Ps. 19:3-4, Acts 17:27, and Rom. 2:14-5) which suggest that even Gentiles without direct knowledge of the Jewish law (or pagans in our time) have access to saving faith. Most obviously, John 1:9 says that Jesus is the Light "that lights every man",[15] presumably including those who do not know Him by either name or office. Thus the fundamental object of faith must be something that God can present to every person with an adequate intelligence, knowledge base, and lack of total societal coercion. One possibility is that the fundamental issue is whether one believes that the organizing power of the universe (*i.e.* God) has our best interests at heart (*i. e.* loves us). This would lead us to follow His will and love each other. With more of a knowledge base we could rapidly bring the one

[15]It does not really matter whether Jesus was "coming into the world" or whether He lights every person "coming into the world". Jesus still lights every person (*anthrōpos*, the generic for mankind).

God of the Judeo-Christian heritage into the picture, then Jesus, then the rest of our theology (or at least someone's theology). If the fundamental attitude does not change, these additions would appear to be natural extensions of that attitude.

This concept can require integrity of a person. If one knows about the life of Jesus, one may be forced to recognize in Him the Messiah. One may not be able to keep one's integrity without confessing that "there is no other name . . . by which **we** must be saved"; for us there may be "salvation in no one else." (Acts 4:12). One may be able to say to someone else that if you believe that Jesus is the Messiah and that God is just like Jesus in His attitude then you shall be saved. Thus this view reduces to the traditional one under the appropriate circumstances.

This view has profound implications for missions. For even in non-Christian lands there are some who are "saved" (it is of interest that missionaries have sometimes observed that "the best pagans make the best Christians", which is disappointing on the theory that they are "saving" people in mission service, but which is expected under the more general model of faith presented above). Thus a minister who brings Christianity to a group does not necessarily give them a chance for salvation. They already have that. He or she may give them another chance, or possibly even a better chance. But so does anyone who presents them with information on the ability and willingness of God to help them, and information on how to serve their fellow humans better (for example, a teacher who gives them an education in God's truth and encourages them to share it, or a health worker who teaches them God's principles of health and encourages them to use their newfound strength to bless others, and especially an Alcoholics Anonymous counselor who encourages their reliance on a "higher power" and their restitution to their family and friends). But some of what preaching Christianity does is to take people who are already saved and release them from the fear and confusion they were living under. Here it is precisely paralleled by the physician who makes people feel better physically, or the teacher who partially satisfies their intellectual thirst. This means that a legitimate goal of missions is to make people feel good.

Does this mean that one does not need to repent before one is saved? Perhaps theoretically. One may construct a situation where a person commits his/her life to God and is immediately killed before he/she realizes the implications of this commitment for his/her former way of life and repents. But in practice it does not take very long to discover that if God is good, He wants us to

be good also, and that we cannot do that on our own, and that we need to repent. In any case, the question is totally irrelevant to you and me, who realize that we have imperfections and that we need to get rid of them if we are to live lives of integrity. We need to repent whether anyone else does or not. We need the new birth that Jesus spoke of in John 3. And come to think of it, it is even possible that God will keep anyone alive who commits to Him until that person realizes, however vaguely, that he/she needs to repent.

This position can take the hypocrisy out of the missionary who feeds or heals people so that they will listen to the Gospel, which is "the only really important thing." No, feeding and healing people is good in and of itself. It can be engaged in for its own sake. Does that mean the end of missions? Only if one's theology cannot stand on its own two feet and must rely on Hell to keep it going. If one's theology is truly helpful, then it is worth sharing, as much as, and maybe more than, food. And according to the general model of faith, a basic imperative is to love others, which includes sharing with them helpful information, including one's theology. So missions should endure, and perhaps even be strengthened, and this without encouraging the bigotry that has sometimes infected missions in the past. At the same time, one will not have the desperation to change others without first identifying their felt needs and ascertaining whether one can truly help.

This subject obviously branches off in numerous directions, such as the consideration of various models of the Atonement, or the implications for religious liberty. For now we will leave these areas and move to one more area where scientific theology may be of particular help, life after death.

10

Life After Death

A traditional theological approach to the subject of life after death has been to assume a model, collect theoretical Biblical texts which indicate that there is life after death and which can be interpreted as compatible with that model, and then stop with the assumption that one is correct. A scientific approach recognizes that there are actually competing models, and looks for empirical as well as theoretical evidence.

First we should note that there are three areas where empirical evidence of life after death have been claimed. First, there is the kind of evidence cited by Raymond Moody in *Life After Life.*[1] According to Dr. Moody, many people have reported all or part of the following experience: A loud ringing or buzzing, a dark tunnel, a floating experience with mind-body dissociation, seeing spirits of dead people, a bright light which is perceived as a benign being, the life passing before the eyes, and being sent back to the world for a purpose (presumably if this being had accepted

[1]Harrisburg, PA: Stackpole Books, 1976.

them, they would have died). Second, there are the reports of dead friends and relatives visiting people through spiritualist mediums (and sometimes without their aid). Finally there are scattered reports of resurrections, the most prominent one being that of Jesus.

Before we evaluate these claims, we should be clear on our definition of death. A very old definition, current in Biblical times, was that death occurred when someone stopped breathing. Later, the definition was switched to when the heart stopped beating. This was doubtless reinforced by a substantial number of near-drowning[2] resuscitations, where simply breathing for the subject caused the return of spontaneous respirations. And today nobody would use the absence of respirations as the sole criterion for death in the presence of a heartbeat and pulse.

Today there is an additional criterion for death: The permanent absence of all brain activity. One can have a heartbeat and all body functions except respiration, which is supported by a ventilator (and can be supported indefinitely), without being a live human in any important sense, if the brain is dead. This concept is nearly universally recognized, and is the basis for many organ donations.

What is not always realized is that a person who is not brain dead is not dead. With advances in medicine we have been able to keep people alive and conscious with someone else's heart, with a baboon's heart, or even with a mechanical heart. In fact, the latter has become commonplace; most people who receive coronary bypass operations have had their hearts stopped for minutes to hours while a machine performed the functions of both heart and lungs. And there was the case of Barney Clark, who had an artificial heart for over 3 months. Of interest, the personalities change negligibly. Furthermore, if someone had cardiac arrest in my emergency department, I could not defend a lack of action, or even an improper choice of action, on the basis that "the patient was already dead and I have no duty to treat a dead person."

Nor is a heartbeat (even a mechanical one) necessary for consciousness. I had a patient once in a small emergency room who had suffered a myocardial infarction (heart attack). I was writing on his chart just around the corner. The nurse left the room for a few seconds. Suddenly we heard a loud "Hey!" from the pa-

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[2]Note the term "near-drowning", instead of the older term "drowning". It is a little difficult to claim someone drowned when he or she is still alive.

tient. We both went charging around the corner to find him unconscious with ventricular fibrillation showing on his monitor. He was pulseless but breathing. While the nurse got the paddles, I started cardiac compressions. He never did need anyone to breathe for him. Within perhaps 45 seconds he was defibrillated and responded with a normal heartbeat and rapidly regained consciousness. He later told us what happened. "I was lying here watching the monitor when it kinda went crazy. I thought something was wrong, so I yelled." This patient was conscious enough to decipher a change in the pattern of his cardiac monitor, decide something was wrong, and do something about it, all with no heartbeat.

All this is not to say that there is no relation between the heart, lungs, and brain. One does not stay conscious forever without some kind of blood circulation to the brain, which almost always means a heartbeat, or without oxygen in the blood, which almost always means breathing. But it does mean that the brain is the only organ that is absolutely required for consciousness, not the heart or the lungs. If one accepts the idea that brain death is adequate to prove death, then it follows that *death is brain death.* One cannot be alive without a brain, and one cannot die without brain death.

This undercuts the claim that people who have had the experiences described by Moody were experiencing "life after life". None of them were brain dead. These experiences should be reclassified as "near-death experiences" (Moody's terminology). They do **not** prove consciousness beyond death.

Might these experiences still represent some kind of "soul passage" to another world? Yes, without further information they could. However, I am troubled by three problems which present themselves when I try to build a theology around these experiences. First, the sensations described, or something like them, happen in other settings. It is common for one who nearly faints (or faints) to have darkness close in from the sides of the visual fields, producing a tunnel. I have had that happen myself. It is not unusual when one is under sudden stress to have one's life pass before one's eyes. A feeling of peace, and a floating sensation with the illusion of mind-body dissociation, can be part of a drug experience, for example. The brain of someone who is having a near-death experience has to be profoundly metabolically deranged at some point. Some other evidence is needed before we can be confident that such experiences represent actual interfaces with a life beyond ours.

Second, not everyone has these experiences when the heart stops. Even Moody recognized that in his sample that a number of his subjects had not had a near-death experience (I have yet to meet someone who has had one and was willing to admit it to me). In fact, Moody himself states (p. 23) that he has not met anyone with more than 4/5 of the elements of his "typical" experience. The presence or content of such an experience does not seem to be related to religious commitment or general goodness, even in a general way. Only the theological belief influences belief in the identity of the bright being, which means we cannot even use the experiences to tell which religion is closest to the truth. I suspect, although I have no data to prove, that near-death experiences are more common if one is awake to begin with. This would fit the metabolic theory more than the other world theory. The fact that some people have the experience and some don't suggests that if it is an interface with another world, some will not make it to that world, so that an afterlife is not for everybody. This is a surprising result in view of almost all theories of the afterlife, and raises questions about the validity of the evidence.

Of interest is that Moody mentions one group that has bad experiences. This group is those who attempt suicide (p. 136-138). This is fortunate for Moody, as otherwise he would be encouraging people to kill themselves so that they could go to this nonjudgmental being who would accept them no matter what they did, and be reunited with their dead loved ones. But somehow I have difficulty believing that suicide (or perhaps killing another) is the only sin worthy of punishment. Would anyone believe that a person who habitually swindled, polluted the enviornment, and caused human suffering without actually physically killing anyone is worthy of less punishment than someone who became depressed under abuse and finally killed herself? What about someone who committed suicide in order not to reveal what he knew of the underground to the Nazis under torture?

Third, I have trouble with the reliability of the witnesses. I do not mean that they are deliberately lying, but that their memory may be poor. Perhaps an experience I had will illustrate the problem. As a house officer I once directed the resuscitation of a lady who had asystole because of renal failure with hyperkalemia (K^+ of 9.7 meq/l!). She arrested in front of us. She was rapidly resuscitated and regained consciousness shortly. After her potassium level was mostly corrected, I asked her whether she had had a near-death experience, starting with neutral questions and then asking more leading ones, trying to get some kind of description. But she denied any such experience. She seemed to

be open.

Six months later, talking to her daughter, I mentioned that I had talked to the patient who had denied having such an experience. The daughter immediately said, "Oh, but she told me all about it", and proceeded to tell me about the tunnel and the light and the whole bit. I did not get a chance to confirm this from the patient, and she is now dead. She was a little confused and not bright enough at the time to have deliberately lied to the daughter. Nor do I think that the daughter was lying. But the two stories do not match, and this leads me to wonder whether memories of these incidents in general might not be confused, or at least influenced by factors other than the actual experience.

So I cannot give much weight to near-death experiences. If they fit a theology, they might be used as minor evidence, but I do not think one should use them as a cornerstone of the theology of the afterlife.

We next come to spiritualistic experiences. These experiences definitely are mostly from people who are dead[3]. So we have to explain the phenomenon.

One way is the way of Houdini. He believed that all of spiritualism was trickery, magic of the kind he did. It is true that some fraud has taken place. Most of the current activity could perhaps be explained by purely materialist magic. But I am not totally comfortable with that as a complete explanation.

One could accept spiritualistic experiences at face value. They do purport to be communications with the dead, and one should always give the simplest viable explanation priority.

However, one has only to read the Old Testament to realize a profound disapproval of attempts to contact the dead. For example, Isaiah 8:20 says, ". . . should not a people consult their God? Should they consult the dead on behalf of the living?" The implied answer to the latter question is "no". This attitude is con-

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[3]There have, I understand, been a few times where still living people are supposed to have communicated through mediums who believed that they were dead, but this is rare, and does not eliminate the possibility of real communication.

Suppose that 99.9% of spiritualistic phenomena were explainable with naturalistic assumptions and 0.1% were not (at present, anyway). If scientific materialism or some other naturalistic philosophy were the only reality, it would be reasonable to assume that we just did not know enough about the other 0.1%. But since our best evidence indicates that naturalistic assumptions cannot completely describe reality (see chapter 2), not only can we not fairly assume that the other 0.1% are naturalistic, but we should actually be prepared for them to tell us something important about the universe.

sistent with the rest of the Old Testament.[4] The New Testament attitude is similar.[5] So if one gives credence to the Bible (and we have good reason to do so), one is reluctant to consider spiritualistic experiences benign.

The Bible does record one seánce. First Samuel 28 records the story of Saul going to see a dead prophet (Samuel) for advice when God would not answer him. The prediction he was given was true, but entirely unhelpful; in fact it was probably damaging. Saul never actually saw Samuel himself. And the theology taught by a straightforward reading of the words of Samuel, although consistent with the theology of the day, is inconsistent with any present theology I know. Note that Samuel was brought up (vs. 8,11,12,15), and was described as "a god coming up out of the earth" (v. 13). This was where Sheol, the realm of the dead, was located, not heaven, where most people would assume Samuel should have gone (at least to "Abraham's bosom" as in Luke 16:22 KJV). Lest there be any question, Samuel said to Saul, whose course of action and attitude seem to be that of someone who is lost, "tomorrow you and your sons shall be with me". The theology appears to be that the dead rest together unless they are called up.

So the Biblical data does not allow one to accept spiritualistic experiences naïvely. There are hints that some of these experiences may be Satanic; Revelation 16:13-4 does speak of "demonic spirits, performing signs." But no specific statement of the source of spiritualistic phenomena is made in scripture. So for now we must leave these phenomena without drawing firm conclusions.

We thus come to resurrection phenomena. The validity of some of them could be questioned. The experiences of Elijah (1 Kings 17:17-24) and Elisha (2 Kings 4:18-37) could be explained by artificial respiration. The stories of Elisha's bones (2 Kings 13:20-1), Peter (Acts 9:36-42), Paul (Acts 20:9-12), and some of Jesus' miracles (Matt. 9:18-26 = Mark 5:21-43 = Luke 8:40-56, Luke 17:11-19) could be explained by mistaken diagnosis, although quite frankly both of these explanations are strained.[6] But two

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[4]See Lev. 19:31;20:6; Deut. 18:9-14; 2 Kings 21:6;23:24; Ps. 106:28; 1 Sam. 15:23; 2 Sam. 28:3.

[5]See Gal 5:19-21; Rev 9:21;21:8;22:15.

[6]The people who were raised not only appeared to be dead, in some cases for hours, but also were originally sick enough that death was expected, and yet did not just recover slowly but appeared to regain health essentially instantly. These events were evidently miracles even if they were only healings, and it seems easier to believe that most if not all of them were also miracles of raising the dead.

resurrections cannot be so explained. Lazarus (John 11) had been dead four days, and had started to decay. And Jesus had been executed, and then had a spear wound in His chest, and lay in the tomb for over 24 hours (whether about 30 or 72 hours does not matter for our purposes). There were also those who were raised at Jesus' death (Matt. 27:52-3) and Moses (who was seen on the Mount of Transfiguration).

Thus there is solid evidence for life after death, and this life happens by resurrection. This matches scattered hints in the Old Testament (Dan. 12:2,13; Eze. 37:1-14, esp. vs. 12,13; 1 Sam 2:6; Isa 26:19; Hos 13:14; Job 19:25-6). This emphasis is strongly reinforced in the New Testament, especially by Jesus (for example, Matt. 22:23-33 = Mark 12:18-27 = Luke 20:27-38; John 5:28-9). Several major passages link a final resurrection to the second coming of Jesus (for example, 1 Cor. 15; 1 Thess. 4:13-18; Rev. 19:11-20:6). This was also the understanding of the early church. The Apostles' Creed, which is still recited in both the Catholic and Anglican churches, speaks of the resurrection of the dead, and the life to come (not the life to come and the resurrection of the dead, as would be expected from later models).

What is the Biblical picture of the state between death and the resurrection? It is overwhelmingly that of sleep.[7] At this point some will protest that they are not comfortable with the idea of sleep, or unconsciousness, between death and the second coming. They had always felt somehow warmed to know that Mother was in heaven. And what about Mary the mother of Jesus, and all the saints? They are not unconscious too, are they?

Well, first we need to remind ourselves that we are on a search for truth, not for comfort. We have no business believing something because it makes us feel good. Rather, we should believe it because it is accurate. In fact, we cannot really believe things we know aren't true without becoming mentally ill. So the feeling that one is being deprived of comfort is not an adequate reason to reject the truth if one is committed to integrity.

Second, it isn't really quite that bad. For if Mother is resting without pain, she cannot be said to suffer (she may even suffer less than a conscious mother watching her children going astray and helpless to do anything about it). And from an experiential standpoint, she meets Jesus immediately upon death. The inter-

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[7]See for example Matt. 9:24 = Mark 5:39 = Luke 8:52-3; John 11:11-14; Acts 7:60-8:1; 1 Cor 15:51; 1 Thess 4:13-17. See also Rev. 14:13.

vening years, or centuries, are not experienced. And while we may lose the ability to pray to saints, we still have Jesus (and for that matter God) to pray to. Perhaps it will take some getting used to, but we will not be left comfortless.

There are more substantial objections. What about the parable of the rich man and Lazarus (Luke 16:19-31)? This parable can be explained from the point of view of soul sleep. It is a parable. Some of Jesus' parables happened many times, for example the parable of the sower. Some probably happened once, like the parable of the good Samaritan. But some in all probability never happened, like the parable of the prodigal son. There is nothing to prevent the parable of the rich man and Lazarus from falling into the third category, and much to indicate that it should. For example, the name Lazarus is generally conceded (by those who believe the literal accuracy of the account) to have been chosen as a deliberate reference to the Lazarus of John 11 (by Jesus, not necessarily by Luke). This Lazarus was apparently not a beggar, and more importantly he did come back to life, contrary to the ending of the parable. If the parable is not literal, there is no need to assume that any details other than the punch line (v. 31) are necessarily accurate.[8]

Then there is the oft-repeated text which states that "whilst we are at home in the body, we are absent from the Lord." (2 Cor 5:6 KJV) Further, Paul and his hearers are "willing rather to be

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[8]We do the same thing today. I have heard, and told, the following story: A man was taken to visit hell. In the first room he saw a long table with many pots of delicious-smelling stew, and people seated around the table, moaning in despair. Their forearms had been elongated so that their hands, which were transformed into dippers, could not reach their mouths, and the mouths of the pots were too small for the people's heads to reach the stew. The people were starving in the midst of plenty. He then visited heaven. In the first room there were again people with spoons for hands and long forearms seated around a table with pots of stew, but here they were all happily feeding each other.

I hope no one draws conclusions about my theology of death based on that story. It should be obvious by now that such conclusions would be wildly erroneous. That does not mean that the story has no point, or that the point is not a valid one.

And the story of the rich man and Lazarus cannot be taken over without modification. We do not expect to be in Abraham's bosom. It wouldn't be big enough for all of us. Besides, if there were someone enfolding us it would be more likely to be Jesus. The great gulf fixed where Abraham can talk with the rich man but no one can go over is highly likely to be a literary device. There is no reason why the parable itself could not have been largely a literary device (or originally an oral teaching device).

absent from the body, and present with the Lord." (v. 8 KJV). A common interpretation of this is that when one is present in the body, one is absent from the Lord, and when one is absent from the body, one is present with the Lord.

But that is not exactly what the passage teaches. The passage actually starts in v. 1, and continues to v. 10.[9] Note that the text speaks of being "naked" (v.3) or "unclothed" (v. 4), which seems to be undesirable. This seems to correspond well to the period of "sleep" between death and the resurrection. It fits less well with a conscious soul which goes straight to heaven or hell. An intermediate state is not mentioned in vs. 6-9, but if the judgment is at the last day, then v. 10 would seem to imply an intermediate state, and it would not be unreasonable to assume it in vs. 6-9 as well. They specifically do not exclude it.[10] Incidentally, vs. 1-5 imply that the glorified state is if anything "further clothed" by a body than our present state. This passage does not prove the absence of "soul sleep", and in fact v. 4 seems to imply it.

There is story of the King of Babylon in Isaiah 14:4-20 of wakefulness in the grave. This story is highly symbolic, and just like the parable of the rich man and Lazarus, not too much weight can be given to it in developing a theology of the grave. Again, the picture is that of sleeping "shades" who are roused and "stirred up" (v. 9), which does not fit any modern theology.

There is the passage in 1 Peter 3:18-20 which speaks of "spirits in prison".[11] Catholics use this text to prove that there is a

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[9]"[1]For we know that if the earthly tent we live in is destroyed, we have a building from God, a house not made with hands, eternal in the heavens. [2]Here indeed we groan, and long to put on our heavenly dwelling, [3]so that by putting it on we may not be found naked. [4]For while we are still in this tent, we sigh with anxiety; not that we would be unclothed, but that we would be further clothed, so that what is mortal may be swallowed up by life. [5]He who has prepared us for this very thing is God, who has given us the Spirit as a guarantee.

[6]So we are always of good courage; we know that while we are at home in the body we are away from the Lord, [7]for we walk by faith, not by sight. [8]We are of good courage, and we would rather be away from the body and at home with the Lord. [9]So whether we are at home or away, we make it our aim to please him. [10]For we must all appear before the judgment seat of Christ, so that each one may receive good or evil, according to what he has done in the body."

[10]The text does not say "to be absent from the body is to be present with the Lord." The possibility remains that one can be absent from the body and "naked", and therefore not present with the Lord. If being "unclothed" is the same as sleeping, and we are "naked", we cannot do anything, and therefore cannot make it our aim to please God, so there is no reason for mentioning the "naked" state in v. 9.

purgatory, a place where sinners (those who did not listen to Noah obviously made the wrong choice) are preached to. Note that this interpretation will not fit into a Protestant theology where the reward is determined at death. These "spirits" cannot be those of the saved who are just learning about Christ after He died.

But this interpretation does not really fit well into a Catholic theology either. For one would have expected these "spirits" to be in hell, not purgatory. There would be no point to having Christ preach to spirits in hell.

There is another passage in 1 Peter where "in the flesh [*sarki*]" is contrasted with "in the spirit [*pneumati*]". In 4:5-6 we read of the judgment of "the living and the dead", which God (Jesus?) "is ready" to do, and so has not done yet. Presumably this will happen at the last day (compare 2 Pet. 3:7,10). Here again "the gospel was preached even to the dead, that though judged in the flesh like men, they might live in the spirit like God." Was it preached after they died, or before they died? Some of them were saved, and that is the reason why the gospel was preached to them. It would appear that either hell is not final, which is not in accord with traditional Protestant teaching (or traditional Catholic teaching either—hell and purgatory are usually separated), or the preaching in 4:6 was done when they were alive (note that the gospel "was", not "is", preached. The Greek is aorist passive).

If the gospel was preached to those in 4:6 while they were alive, then could those in 3:19 have been preached to while they were still alive? Not if the gospel has to be the good news about Jesus. These people lived long before Him. But perhaps we have too narrow a concept of the gospel. That there has always been a gospel is implied in Rev. 14:6, where we read of an "eternal gospel". In 1 Peter 4:6 one suspects that at least some of those to whom "the gospel was preached" were living before the time of Jesus, and therefore the gospel may not necessarily have to contain all the details of His life. In that case, the gospel may have been preached to the "spirits in prison" "when God's patience waited in the days of Noah, during the building of the ark, . . ."

Why call them "spirits in prison"? It could be because they

11"18For Christ also died [some mss. read "suffered"] for sins once for all, the righteous for the unrighteous, that he might bring us to God, being put to death in the flesh, but made alive in the spirit; 19in which he went and preached to the spirits in prison, 20who formerly did not obey, when God's patience waited in the days of Noah, during the building of the ark, in which a few,that is, eight persons, were saved through water."

were unable (or unwilling) to break out of Satan's prison house. Or it could be because they are being kept for the judgment, somewhat like the angels of 2 Pet. 2:4.

What about the phrase "made alive in the spirit" or "live in the spirit"? Does this denote an existence after death? Yes, it does. But the example that is given is that of Christ, who was made alive in the spirit when He was resurrected. The experience of the righteous dead in 1 Pet. 4:6 may be expected to parallel His.

There is the story about the thief on the cross, who was promised by Jesus Himself, according to most translations, "Truly I say to you, Today you will be with me in Paradise." (Luke 23:43) This would imply that the thief went straight to heaven when he died.

However, this interpretation is strained. For if insisted upon literally, it would require Jesus to go to heaven when He died, whereas the Biblical picture has Him doing that at His ascention (see also the Apostles' Creed!), and specifically excludes His going to the Father at death (John 20:17). Instead, He was in Hades (in this context a direct translation of *Sheol*), according to Acts 2:27-31 (from which we get the Catholic doctrine of the Descent into Hell). Thus the above interpretation appears to be strained.

There are two more ways to understand the text. First, it may have been an experientially accurate description. For if the thief died that day, which is probable, then when he awakens, which for his experience will be the same day, he will be with Christ. Second, the punctuation, which was not in the original, may have been inserted in the wrong place, so that the text should read, "Truly I say to you today, you will be with me in Paradise."

But perhaps the major objection to the picture of soul sleep comes from the doctrine of the immortality of the soul. One might say that the Biblical picture is that the soul that sins will die (Eze. 18:4,20) and that only God has immortality (1 Tim 6:16). But there is perhaps a more fruitful line of inquiry. There are three models of the afterlife we shall consider, that of soul annihilation, soul sleep, and soul immortality. The first two are actually indistinguishable in their predicted effects. For if one cannot receive information from one's enviornment, and cannot transmit information to one's enviornment, then as far as the enviornment is concerned, one might as well not exist (souls may even need bodies to interact with the enviornment). Therefore, unless someone can show where the unconscious souls are sleeping, scientific theology would not recognize any essential difference between the two theories.

However, soul immortality is compatible with soul sleep, as

long as we do not insist on **conscious** immortality. The predictions are phenomenologically precisely the same. Thus if one wants to insist on an immortality of the soul, it only has the traditional meaning if one insists on the **conscious** immortality of the soul. And this belief can be experimentally falsified, and in fact is falsified by most of us every night. For every time we go into sleep, and sleep without dreams, we falsify the doctrine of the (conscious) immortality of the soul. In this case, philosophy should bow to experience. Let me emphasize the point one more time. *The soul is not immortally conscious.* We know that from experience.

This point has one other consequence which I wish to explore. We are not bound by philosophical considerations to believe that the wicked are tortured forever in Hell. So we should see what other evidence there is for the duration of their punishment. Jesus did not say anything which proves that **conscious** punishment is eternal.[12] He does refer to "eternal fire" (Matt. 18:8;25:41; as well as eternal punishment in 25:46). But one must use these texts cautiously, as in Jude 7 Sodom and Gomorrah are referred to as suffering "eternal fire"[13] (compare 2 Pet. 2:6 where they were turned to "ashes"). On the other hand, John (quoting Jesus?) refers to the wicked as perishing (3:16), as contrasted to having eternal life, suggesting that at some point they cease to be.[14] There is a third picture of the wicked as being cast in "outer darkness" where they "weep and gnash their teeth" (Matt. 8:12;22:13;25:30). This picture gets a little clouded when it is noted that in one instance (Matt 13:42) fire is part of it. I have difficulty visualizing dark fire (two references, Matt. 24:51 and Luke 13:28, do not mention either darkness or fire).

So although there are trends, the words of Jesus do not settle the question. There are only a few other texts in the New Testa-

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[12]He did say in Mark 9:48 that in Hell (Greek *Geenna*, or *Gehenna*) "their worm does not die, and the fire is not quenched." (quoting Isa. 66:24) But the picture here is of rotting flesh in a garbage dump, not conscious souls in agony. It is even reasonable to suggest that the bodies are dead before they are substantially burned. Certainly this is the case in the passage in Isaiah.

[13]If you are following along in the KJV, it may help to know that the Greek words are the same.

[14]The same Greek word is used in Heb. 1:11 to refer to the earth and the heavens, in Matt. 9:17 = Luke 5:37 to describe wine bottles, in Matt. 8:25 = Mark 4:38 = Luke 8:24 to describe the threatened fate of the disciples on the Sea of Galilee, in Luke 13:3,5 to describe the fate of people who were killed by the Romans or natural disaster, and also sinners, in Luke 21:18 to describe the fate of (head) hairs, and in 2 Pet. 3:6 to describe the antediluvian world.

ment outside of Revelation which refer to punishment with apparent reference to its duration. Heb. 6:2 refers to "eternal judgment". Of course, that does not require eternal consciousness, any more than "eternal fire" does. Nor does the "eternal destruction" of 2 Thess. 1:9, which might actually imply final destruction. Jesus' "outer darkness" is mirrored in Jude 13, where the "gloom of darkness has been reserved for ever" for certain evil men (the parallel in 2 Pet. 2:17 does not have "for ever"). This experience is apparently parallel to Jude 6, where the wicked angels have been kept in "eternal chains in the nether gloom until the judgment of the great day; . . ." (again the parallel in 2 Pet. 2:4 is missing the word "eternal")

This brings us to Revelation. There are 3 texts which associate the punishment of the wicked with the words "forever and ever". In Rev. 14:11, speaking of those who worship the beast and his image, we are told that "the smoke of their torment goes up for ever and ever [*eis aiōnas aiōnon*]; . . ." In Rev. 19:2-3 we read of "the smoke" from "the great harlot" which "goes up for ever and ever [*eis tous aiōnas tōn aiōnon*]". And in Rev. 20:10 the devil, the beast, and the false prophet "will be tormented day and night for ever and ever [*eis tous aiōnas tōn aiōnon*]." These texts, particularly the last one, seem to indicate eternal punishment.

But we can find the same phrase used in the Old Testament (the Septuagint is sometimes even stronger than Revelation) to describe actions or entities which do not last forever in our modern use of the term. In Ps. 52:8 David states, "I trust in the steadfast love of God for ever and ever."[15] Again, "I will keep thy law continually, for ever and ever" (Ps 119:44).[16] See also Ps 145:1,2.[17] David obviously died. According to the Psalms, he cannot be praising God now (for "The dead do not praise the LORD, nor do any that go down into silence. . . .", according to Ps. 115:17. Compare Ps. 88:10). He certainly cannot if he sleeps in death. Thus his "forever and ever" appears to have lasted only unto death. In fact, in the Massoretic text (followed by the KJV) of Ps. 48:14, "for ever and ever" is parallel with, and presumably equivalent to, "unto death".[18]

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[15]LXX (51:10) *eis ton aiōna kai eis ton aiōna tou aiōnas*; MT (52:10) *ʿwlm wʿd*. The LXX would usually be translated "forever and forever and ever".

[16]LXX (118:44) *eis ton aiōna kai eis ton aiōna tou aiōnas*; MT *ʿwlm wʿd*.

[17]LXX (144:1,2) *eis ton aiōna kai eis ton aiōna tou aiōnas*; MT *ʿwlm wʿd*. Also Ps 21:4 (LXX [20:5] *eis aiona aionos*; MT [21:5] *ʿwlm wʿd*) could be Messianic, but it more probably originally referred to David who was given "length of days for ever and ever." Nehemiah 9:5 is probably more properly translated as in the RSV than as in the KJV ("for ever and ever").

Furthermore, the passages of Revelation obviously allude to Isa 34:9-10 where "the streams of Edom shall be turned into pitch, and her soil into brimstone; her land shall become burning pitch. Night and day it shall not be quenched; its smoke shall go up for ever [Massoretic text *l'wlm*; Septuagint *eis ton aiona chronon*]. From generation to generation it shall lie waste; none shall pass through it for ever and ever."[19] But even though the smoke goes up "for ever", various animals will live there (vs. 11-17). The smoke going up "for ever" simply does not mean that the burning never stops. We may not agree with the wisdom of this use of language. But we cannot honestly say that the Bible writers had to mean something when they wrote these texts because that is what we would have meant. Understanding them on their own terms, they simply did not intend to imply endless duration when they used the term commonly translated "for ever and ever".[20]

There is another picture we should notice, which starts in the OT and works its way to Revelation. In Isa. 66:24 the "dead bodies" of those who rebel against God have a "fire" that "shall not be quenched" consuming them. Note that the bodies are dead. In Mal. 4:1-3 the wicked "will be stubble; the day that comes shall burn them up," so that "they will be ashes under the soles of your feet." In Matt. 10:28 we are told to "fear him who can destroy both soul and body in hell." In Matt. 25:46 "eternal punishment" is contrasted with "eternal life". We have noted John 3:16 above.

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[18]The MT has *ʿwlm w ʿd* and *ʿl-mwt*. The original may have been *ʿlmwt*, which is ambiguous, or *wlmwt*, which is usually translated "forever". However, this is an unusual form; the standard form (for example, v 9 MT) is *ʿwlm* (or more precisely *gd-ʿwlm*). In any case the writers of the MT seemed to be able to equate "forever and ever" with "until death". The LXX (47:15) translates the two phrases "*eis ton aiōna kai eis ton aiōna tou aiōnas*" and "*eis tous aiōnas*".

The MT uses *ʿwlm w ʿd* in Ps. 104:5, and the meaning "forever" is difficult to maintain here. It is true that the psalmist may have meant "forever". But other Biblical material indicates that the foundations of the earth can be shaken (Isa 24:18).

[19]The MT of the final "for ever and ever" is *lnṣḥ nṣḥym*, which can be translated "constantly" or "perpetually". The LXX is *eis chronon polun*, which can be translated "for a long time". Incidentally, the LXX also has the "forever" transposed so that the fire will not be quenched forever, rather than having the smoke ascend forever. Presumably Revelation is following the reading found in the MT rather than the Septuagint.

[20]This is not to say that the term is used in a totally capricious way. The Biblical writers could probably have given a definition to the term. They probably meant something like "as long as the object referred to is in existence."

Rom. 6:21-23 has a similar contrast. Verse 23 states that "the wages of sin is death [not 'eternal torment'], but the gift of God is eternal life in Christ Jesus our Lord." John 5:29 speaks of "the resurrection of life," which contrasts with "the resurrection of judgment." There is "the lawless one" of 2 Thess. 2:8 who will be slain, and destroyed, at the second coming of Jesus. Heb. 10:27 mentions a "fury of fire which will consume the adversaries." 2 Pet. 3:7 speaks of "fire" which results in the "destruction of ungodly men." And Rev. 20:6 speaks of the "second death", which, if it is parallel with the first death, should result in unconsciousness. This happened in vision when "fire came down from heaven and **consumed** them, . . ." These texts all seem to indicate that there will be an end to the consciousness of the wicked. One can evade their force, but it puts a certain strain in one's model.

The model of eternal torment has another problem. It makes God appear to be worse than Hitler or Pol Pot. At least their victims eventually died. One may object that we should not use our reasoning to limit God, and this objection has some weight. But Jesus sometimes used the same basic kind of reasoning. He implied that our sense of fairness and compassion is not completely corrupted when He said, "If you then, who are evil, know how to give good gifts to your children, how much more will your Father who is in heaven give good things to those who ask him!" (Matt. 7:11. See also Luke 18:1-8) So although it may not decide the question, the consideration of God's character must be given some weight.

Finally, we do have empiric evidence which bears on how God treats lost people, and it is inconsistent with any kind of vindictiveness. The evidence comes from John 13:21-30. There are two accounts of this story, the other one being Matt. 26:20-5. Matthew has Jesus pointing out Judas in an unmistakable way. In hindsight the disciples recognized that He had done so, and so Matthew's account is not totally wrong. But it is probably a summary (as Matt. 9:18-26 is of Mark 5:21-43—see Luke 8:40-56) with its attendant compression and distortion.[21] The Johannine account has Jesus saying that He would be betrayed. Then He is asked who it is. He does not answer directly. Rather, He says, "It is he to whom I give this morsel when I have dipped it." The disciples could easily have taken that answer at the time to mean

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[21]Ellen White followed Matthew in *The Desire of Ages* (Mountain View, CA: Pacific Press Publishing Company [now Association], 1898). I do not think that she is definitive for this question, for the reason given in Chapter 3.

that it was one who was eating at the table with Him. Perhaps there was a pause, or a change of subject. In any case Jesus' giving the morsel to Judas afterwards was sufficiently unobtrusive that no one else immediately caught on.

At this point Judas made his final choice, and "Satan entered into him." (v. 27). Jesus could have exposed Judas, and gotten a few points with the disciples, without making any difference in Judas' eternal salvation or lack thereof. But instead, He said, "What you are going to do, do quickly." He thus gave Judas a chance to escape without facing the ire of the other disciples. The rest of the disciples were confused (v. 28). "Some thought that . . . Jesus was telling him, 'Buy what we need for the feast'; or, that he should give something for the poor." (v. 29)

By being kind to Judas, Jesus could not "save his soul". The only gain was the partial happiness of a totally lost man. Yet Jesus still felt it worthwhile. This means that we may also feel it worthwhile. But even more importantly, remember that Jesus is God, and gives us a picture of the Father's attitude. This means that God is also unwilling for anyone to suffer more than absolutely necessary to preserve freedom of choice. So if all have made their choices, there is no point in keeping them suffering endlessly except that they cannot die, and we have seen that they could be put to sleep instead. In fact, it may be worthwhile to explore models where the punishment of the wicked is the natural outgrowth of their own choices, rather than something arbritrarily imposed by God. It is even possible that some who never had the opportunity to choose, for example, the severely mentally retarded or very young children, will not be resurrected, but will simply be allowed to continue sleeping. In any case, with the data at our disposal, one does not have to swallow the doctrine of eternal torment in order to be a true Christian.

11

Summary

The central premise of this book is that the fields of theology and science are not exclusive of each other, but fundamentally united as part of one world. This is true, not only of the data, but also of the method. There will be variations of the method forced upon it by the various kinds of subject matter, but the underlying process is the same. We continually refine our theological doctrines, as well as our scientific theories, by comparing them with the data, both old and new, that can be brought to bear on the subject. While doing this, we must continually remind ourselves that the data are primary.

We then noted that the existence of science argues strongly for the existence of a God. From astronomy we can deduce that He is outside the universe and yet created it. From quantum mechanics we can deduce that He is continually active in sustaining it. From the fact that life is here, coupled with the complete inadequacy of any scientific explanation for its origin, we can deduce that He is capable of superseding what we commonly call natural law, and of performing what we ordinarily call

miracles. Thus the secular humanist denial of miracles is seen to be invalid, and a theology which involves the supernatural is necessary.

We then dealt with the minimum requirements one might expect from a religious authority. We dealt with what makes it an authority, and what requirements it might need to fulfill to function within a canon, that is, to make it a religious authority. Inerrancy in all details is not a requirement for a religious authority, any more than it is for a secular authority, but a fundamental transparency is. No religious authority has any authority just because it says so. It is authoritative only because and insofar as it allows the truth to come through it unchanged. Four principles for evaluating information from an authority were developed. First, a presumed authority should be considered accurate unless a substantial weight of evidence contradicts it. Second, statements which could be shown to not claim divine authority, to be believed by influential contemporaries, and to be wrong, can be safely ignored without damaging the authority of the rest of a religious authority. Third, the main point(s) of any revelatory event must be correct if the religious authority is to have any meaningful authority. Conversely, if a religious authority is dependable, the main point of any revelatory event within that authority is dependable. Finally, minor points in a revelatory event can be inaccurate without destroying the authority, although the inaccuracies should be understandable given the worldview of the one receiving the revelation.

We then reviewed the Biblical record and noted that without a naturalistic pressure to deny miracles, it could be taken fairly straightforwardly. The resurrection of Jesus has been documented quite impressively from the point of view of history. The historicity of the rest of the New Testament follows quite naturally if the resurrection is granted. The historicity of most of the Old Testament follows, with the only major historical arguments which do not depend on naturalistic presuppositions now centering around Daniel and around Joshua and the Pentateuch. In the case of Daniel, we noted that the available evidence argued strongly for a conservative as opposed to a Maccabean date for its composition, and that evidence was especially persuasive given the early predictions of the respective camps.

We did not have time to deal with all the questions one might raise concerning the Hexateuch. Specifically, we did not deal with the placement of the Exodus and the Conquest in secular history, or with the age of composition of the documents. However, we did

deal with the reliability of the material in Genesis 1-9 as interpreted in a straightforward manner, and this led us into a consideration of radiometric dating. In what will surely come as a surprise to many, the various dating methods, such as potassium/argon, rubidium/strontium, uranium/lead, and uranium disequilibrium dating, actually were more compatible with a short chronology of life on earth than with a long chronology, and this without altering the radioactive time constants. In the case of carbon-14 dating, the evidence is almost conclusive that most fossils are less than 60,000 years old, and a straightforward flood model suggests an age of 4000 to 8000 years. A few careful experiments with accelerator mass spectrometry could make the evidence conclusive.

The method of theology outlined above, using the Bible as source material, was then applied to several subjects. A scientific perspective on the relationship of God to time satisfactorily solves the problem of God's foreknowledge of free choice. A similar perspective on the Trinity suggests the best way to know the character of God, and also cautions against the uncritical acceptance of explanations of the atonement that demand a forgetful or unloving God. Sin in the Biblical sense is noted to have a complex definition, with not all senses necessarily fulfilled in a given situation. Specifically, it can refer to an attitude, acts derived from that attitude, harmful acts, addictions or character traits, or possibly a nature (although the latter concept was not explored significantly). This concept led us to apply the term with caution. The concept of salvation was explored, with results which should reduce the amount of hypocrisy in missions while increasing the joy. Finally, the concept of life after death was explored, with phenomenological evidence for its existence noted. The theological watershed was noted not to be whether the soul (or spirit) was immortal, but whether it was consciously immortal, and this is subject to experimental study by all of us. A Biblical view of life after death revolves around the Second Coming of Jesus, and does not have to put God in the position of being the most sadistic torturer of all time.

Throughout the book I have endeavored not only to argue for positions which I thought were sound, but to avoid overstating my arguments and to instead give alternative positions and their rationales. In particular, there are some places where the evidence is not conclusive now but could become more so if certain experiments were carried out. I have tried to suggest such experiments. This mode of operation would seem to be mandatory

for a theology that expects to be judged by the criteria used in science to distinguish progressive from degenerating research programs. I would be delighted to see such experiments done and plan to be active in getting as many of them done as I can.

This book has obviously not exhausted all there is to theology, or even outlined all the contributions a scientific theology might make. It has in all probability made some mistakes in its presentation. However, I believe that it has outlined a method, and given enough examples of the use of that method so that it can be understood. I believe it is the best method currently available, and hope to expand its use. I hope that it has proved helpful to you. Perhaps some of you have improvements to make. If so, do not be surprised if I test them. But if they stand the test, I welcome them. For we are all in this together.

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Index - Subjects

Primary sections are in **bold** type.
Related concepts are in *Italics.*

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